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A New Transmission Chain.

The prevalence of the bicycle has made everybody familiar with the peculiar difficulties of the chain and sprocket-wheel method of transmitting power. Wear increases the pitch of the chain and does not materially, if at all, increase the pitch of sprocket wheels, and the difference in pitch goes on increasing until ultimately a time comes when it can no

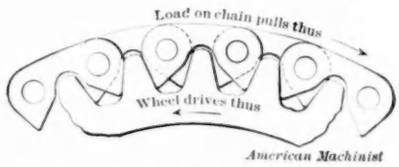

FIG. 1.—WHEEL AND CHAIN ARE NEW.

longer be endured. With well constructed chains and wheels, working under good conditions and not overloaded, this time may be long postponed, but it is inevitable nevertheless.

Mr. Hans Renold, of Manchester, Eng-

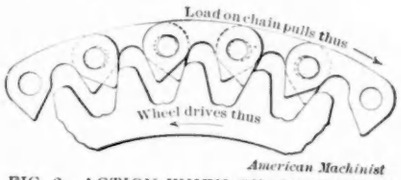

FIG. 2.—ACTION WHEN CHAIN IS MUCH WORN AND LENGTHENED.

land, has a good sized and very good and well equipped factory devoted to making transmission chains, and in the chain which we herewith illustrate he has attempted to overcome the difficulty referred to by providing a chain which, as its pitch increases by wear, will automatically adjust itself and run on the wheels properly.

He has made a great many of these chains, and when the writer was in Mr. Renold's factory, about a year ago, a number of them were to be seen running transmitting power from shaft to shaft, driving emery wheels, etc., and all running with a smoothness and freedom from noise that left nothing to be desired.

The chain is composed of a number of thin sheet steel links, placed side by side, to make up any required width of chain; every link in the chain being just like every other link.

The action of the chain upon the wheel will be understood from an inspection of the diagrams Figs. 1, 2 and 3. In Fig. 1 the chain is shown as it is designed to run when new, and in Fig. 2 the same chain and wheel are shown when the latter is supposed to have worn so as to have its pitch materially increased; in fact, about .6 of an inch per foot, the diagram being about two-thirds the size of chain. It will be seen that when the chain runs onto the wheel it simply goes down over the inclined sides of the teeth until it comes to a seat, and then stops at a point at which pitch of wheel and chain are equal.

At Fig. 3 the action of a link in leaving the wheel is shown, the various centers about which it turns being indicated, and, as will be seen, there is no sliding contact.

The wheels are, of course, made especially for these chains, and the shape of the wheel teeth is varied with its diameter, the same as with spur gearing, the wheels being carefully cut.

By this system the load is not all borne by one tooth and passed on from tooth to tooth, but the action is much more nearly like that of a belt; in fact, we are informed that people who for the first time see these chains running noiselessly up to 1,600 feet per minute often mistake them for leather link belts.

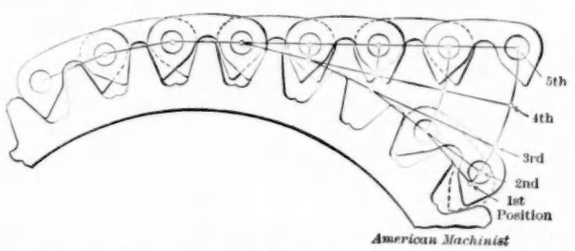

FIG. 3.—DIAGRAM OF CHAIN LEAVING OR ENTERING THE WHEEL

These chains were used on the special milling machines which we illustrated in our issue of November 4, 1897, where they are shown in use for driving the feed motion. It seems to us that this chain will be found superior to belts in many places, and that in machine construction it could with advantage often replace trains of spur gears or bevels and a shaft. One of its advantages over belts is that no tension is needed to make it hold, and so, except where weight of the chain is important, practically all pressure imposed upon a bearing is effective, *i. e.*, needed for imparting the required motion.

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A New Graphical Method of Finding the Areas of Irregular Diagrams.

BY ALFRED E. WIENER, E. E., M. E.

It often happens to the practical engineer that the area of some irregular curve has to be found when a planimeter is not at hand. In the following is given a graphical method for measuring irregular planes which the writer has found very useful for quickly and accurately determining the areas of alternating current waves, hysteresis loops, station-load curves, indicator diagrams, etc., the practical operation being so simple that, after but little practicing, anyone can successfully compete with the manipulator of a planimeter, especially when considering the fact that the latter ordinarily does not depend upon a single measurement, but usually gives the average of several trials, while a repetition of the graphical method is not necessary.

If an irregularly bounded plane by a system of parallel lines is subdivided into strips so narrow that the portions of the boundary curve between any two division lines can practically be considered as straight lines, then a system of rectangles is obtained, and the problem of the quadration of the irregular plane is reduced to the process of adding all these rectangles.

Denoting the dimensions of any one of these elements by x and y, Fig. 1, the area of one element is xy, and the area of the whole plane A is the sum of all the rectangles xy, and can, in mathematical signs, be expressed by

$$A = \Sigma\,(x\,y) \qquad (1)$$

This formula, however, is only an approximation, which comes the nearer to

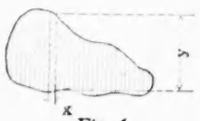

Fig. 1

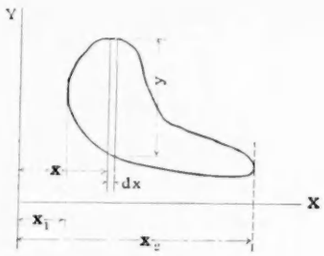

Fig. 2

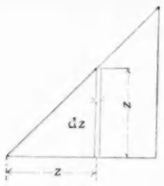

Fig. 3

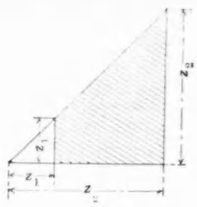

Fig. 4

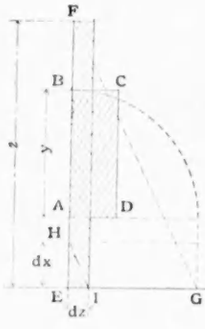

Fig. 5

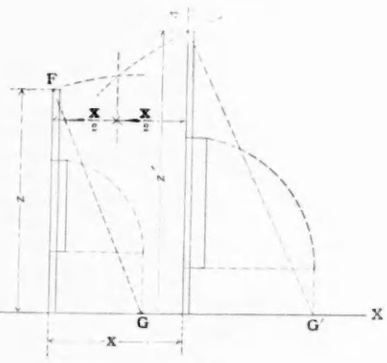

Fig. 6

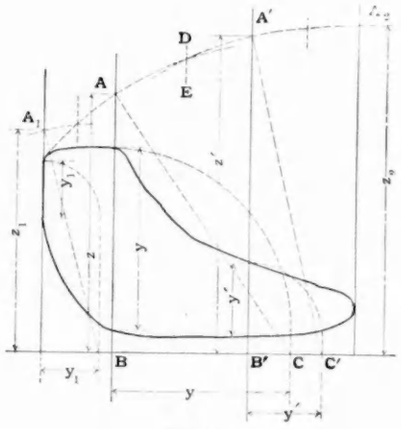

Fig. 7

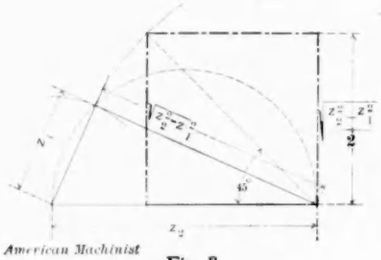

Fig. 8

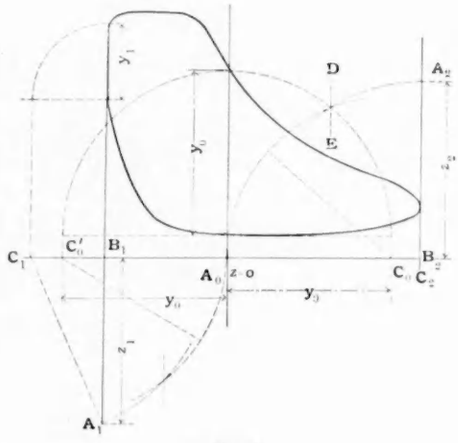

Fig. 9

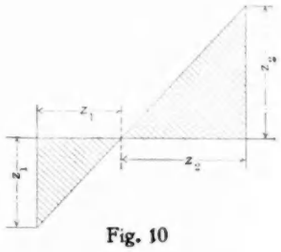

Fig. 10

the mathematical truth, the smaller the widths x of the elements are chosen. In order to exactly express the area A of the irregular plane, therefore, we must take the widths x infinitely small; that is, we must divide the given plane in an infinitely large number of elements.

The process of adding an infinitely large number of infinitely small quantities is called *integration;* the result, or the sum obtained by integration, is called the *integral,* and the infinitely small parts of the quantity to be integrated are termed the *differentials* of that quantity. An integral is designated by the symbol $\int$, and the differential of a quantity is designated by placing the letter d before that quantity. Replacing, therefore, in equation (1) the definite value x by the differential dx, then the symbol Σ for the sum of a definite number of definite quantities must be replaced by the integral symbol $\int$, and the area of the plane is expressed by the integral

$$A = \int y\, dx \qquad (2)$$

In this equation it is supposed that the area has been divided into an infinite number of vertical strips, for, in analytical geometry, it is customary to fix the position of a plane by means of two perpendicular lines, the *horizontal* one of which is called the axis of *abscissae,* and is designated by X, while the *vertical* one is termed the axis of *ordinates,* and is designated by Y.

If the plane to be integrated is limited, extending between two ordinates having the abscissæ x_1 and x_2, respectively, Fig. 2, then the integration also extends between the values x_1 and x_2, and the mathematical expression for the area of any limited plane is given by the *limited* or *definite* integral

$$A = \int_{x_1}^{x_2} y\, dx \qquad (3)$$

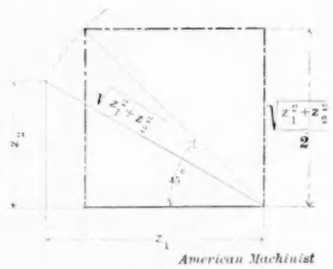

Fig. 11

THE AREAS OF IRREGULAR DIAGRAMS.

INTEGRATION BY MEANS OF AN AUXILIARY QUANTITY.

For the general case of an entirely ir-

regular plane the values of the ordinates y do not depend in any way upon the corresponding abscissæ x or y is not a *function* of x, and, in order to solve the integration indicated by equation (3), it is necessary to replace the differential $y dx$ by a differential depending upon a third quantity, z. Let, for this purpose,

$$y\,dx = z\,dz \qquad (4)$$

then we obtain

$$A = \int_{z_1}^{z_2} z\,dz \qquad (5)$$

where z_1 and z_2 are the values of the auxiliary quantity z, corresponding to the end-abscissæ x_1 and x_2.

But an integral of the form $\int z\,dz$ represents the sum of the areas of an infinite number of rectangular elements, Fig. 3, each of which has a hight equal to its distance from the starting point of the integration, both the hight and the corresponding distance being $= z$. Elements of this property are possessed only by the right-angled isosceles triangle, the area of which is equal to half the square of one of the equal sides. Consequently,

$$\int z\,dz = \frac{z^2}{2} \qquad (6)$$

Taking this integration between the limits z_1 and z_2 we obtain Fig. 4,

$$A = \int_{z_1}^{z_2} z\,dz = \frac{z_2^2 - z_1^2}{2} \qquad (7)$$

The area of the given irregular plane, therefore, is readily given by means of the end values z_1 and z_2 of the auxiliary quantity, and the whole problem is brought down to the determination of the values z_1 and z_2. This problem can be *graphically* solved by constructing a curve representing the auxiliary quantity z.

CONSTRUCTION OF THE Z-CURVE.

Any point of the z-curve must fulfill the condition given in equation (4), namely,

$$y\,dx = z\,dz,$$

which has the geometrical meaning that the rectangles of the sides z and dz must be equal in area to the rectangle of the sides y and dx. Let $A\ B\ C\ D$, Fig. 5, be one of the rectangular elements of the given irregular plane, and $E\,F = z$ the arbitrarily chosen hight of the corresponding auxiliary rectangle; then the breadth $E\,I = dz$ of the auxiliary rectangle is found by making $E\,G = A\,B = y$ and $E\,H = A\,D = dx$, and by drawing $H\,I \parallel F\,G$; for then we have

$E\,G : E\,F = E\,I : E\,H$, or $y : z = dz : dx$,

which is identical with equation (4).

In repeating this construction for a second point of the z-curve in the distance x from the former the hight z' of the second auxiliary rectangle can no longer be arbitrarily chosen, but must be derived from the hight z of the first auxiliary rectangle in such a way as to obtain a continuous boundary curve when joining all the auxiliary rectangles into one auxiliary plane. To achieve this continuity of the z-curve the arcs drawn through F and F' with the radii $G\,F$ and $G'\,F'$ respectively, Fig. 6, must intersect each other in an ordinate midway between z and z'; that is, they must meet at the distance $\frac{x}{2}$ from either of the two z ordinates.

Hence the z-curve is to be constructed by proceeding as follows:

A system of ordinates is drawn across the given plane, and in any one of them, $A\ B$, Fig. 7, the first point A of the z-curve is arbitrarily assumed; then $B\,C$ is made equal to the hight y of the given plane in the ordinate $A\,B$, and an arc is drawn through A with C as center. Through the intersection of this arc with the line $D\,E$, midway between $A\,B$ and the following ordinate $A'\,B'$, an arc is described with C' as center, the point C' being obtained similarly to C by making $B'\,C' = y'$. At the intersection of this second arc of the radius $C'\,D$ with the second ordinate $A'\,B'$ the second point A' of the z-curve is then obtained. In precisely the same manner a sufficiently large number of points at either side of $A\,B$ is constructed, and thus the end points A_1 and A_2 of the z-curve are finally arrived at, thereby determining the end values z_1 and z_2 of the auxiliary quantity.

Quadration.—Having found z_1 and z_2, a *square* can easily be constructed whose area is equal to that of the given irregular plane.

In taking the greater value, z_2, Fig. 8, for the hypotenuse of a right-angled triangle, and the smaller value z_1 for one of the sides, the other side will be $\sqrt{z_2^2 - z_1^2}$; that is, the diagonal of the required square, which itself will be obtained by swinging the diagonal found into a position inclosing an angle of 45° with the abscissa, and by dropping a perpendicular from its end point upon the axis of abscissæ.

The result obtained will be the more accurate (1) the better the number and the distribution of the ordinates is chosen with reference to the shape of the plane to be integrated, and (2) the greater the difference $z_2 - z_1$ of the end values.

The *maximum value* of the difference of two quantities is twice the larger number, which is realized by making the smaller quantity equal in amount but of opposite sign to the larger one, $z_1 = -z_2$: $(z_2 - z_1)_{\max} = z_2 - (-z_2) = 2z_2$.

This condition of maximum difference is fulfilled when the starting value of z is made $= 0$, and taken in the ordinate which exactly halves the area A, for one-half the z-curve will then be above and the other below the axis of abscissæ, and the c..d values, representing half the area A each, will be equal.

The position x_0, Fig. 9, of the bisecting ordinate y_0 being unknown, the starting point $z = o$ has to be assumed in A_0 by estimation.

The construction of the z-curve in this special case differs but little from the general method shown in Fig. 7.

From A_0, Fig. 9, the center ordinate y_0 is brought both to the right and left, thus furnishing two centers C_0 and C_0', from each of which an arc is described through A_0; the arc from C_0 above, and that from C_0' below the axis. Further points of the z-curve are then obtained by considering each side of the center ordinate separately, proceeding as in the general case; and the end values received are of similar size but of opposite sign.

The integration now being taken between the limits $-z_1$ and $+z_2$ the value of the integral representing the area of the irregular plane becomes (Fig. 10):

$$A = \int_{-z_1}^{z_2} z\,dz = \frac{z_1^2 + z_2^2}{2} \qquad (8)$$

and the square representing this area, consequently is to be constructed by making its diagonal the hypotenuse of a right-angled triangle having z_1 and z_2 for its sides, as shown in Fig. 11.

Combining the construction of the z-curve indicated by Fig. 9, and the squaring of the end values given in Fig. 11, a practical method for the graphical quadration of irregularly bounded planes is obtained.

Practical Operation.—In Fig. 12 this method is applied to a practical example, the proceeding being as follows:

A horizontal line $A\,B$ is drawn at a convenient distance from the area to be measured, and a vertical line $C\,D$ is placed at such a point as to approximately bisect that area (this is not to say that the line $C\,D$ shall be about halfway between the ends of the given figure, but that it shall divide it into two parts of nearly equal contents). Next a number of vertical lines are laid across the figure, close together in regions where the width of the figure undergoes rapid changes, and farther apart where it varies but gradually. At the right of $C\,D$ these lines are drawn from the horizontal $A\ B$ upward, while on the left hand they are extended some distance below it. The width $C\,D$ is then laid off from o (the point of intersection of $C\,D$ with $A\,B$) to both the right and the left, giving two points o' upon $A\ B$, for both of which the condition $o\ o' = C\,D$ is fulfilled. For all ordinates at the right hand side of $C\,D$, the respective widths of the irregular figure are similarly laid off on $A\,B$ to the right, and for the ordinates on the left hand of $C\,D$ they are swung over to the left, thus, for instance, $1\ 1' = E\,F$; $9\,9' = G\,H$, etc. In this manner the points, 1', 2', 3' ....15' upon $A\,B$ are obtained, and now the auxiliary curve can be constructed. With o' as center an arc is drawn from o to half-way between ordinates o and 1; this arc is continued with 1' as center to midway between ordinates 1 and 2, at which point the center is again changed

to 3′, and so on to the last ordinate 8, when the point (8) is obtained, the length 8, (8) being the end value z_2. The latter is combined with the other end value 15, (15) constructed in the same manner, into a right-angled triangle (8), 8, M. From M a line is drawn at an angle of 45° with LB and MK made equal to M (8). The area of the square K L M N thus found, having sides of $1^{19}/_{32}$ inch length, is 2.84 square inches, while the given plane, accurately measured by means of a planimeter, was found to contain 2.55 square inches.* The result obtained by the graphical method, consequently, differs from the actual area by an amount of only 4 10 of 1 per cent., and could have been approached still closer if a greater number of ordinates had been taken.

* The figure given is the average of five careful measurements.

While Fig. 12 has all the construction-lines dotted in for sake of explanation, in practice neither the quadrants determining the centers 1′, 2′, etc., nor the radii of the arcs forming the auxiliary curve need be shown, all that is necessary being to draw the ordinates, mark off the corresponding centers by means of a pair of dividers, and by the use of a compass plot directly the auxiliary curve, the geometrical mean of

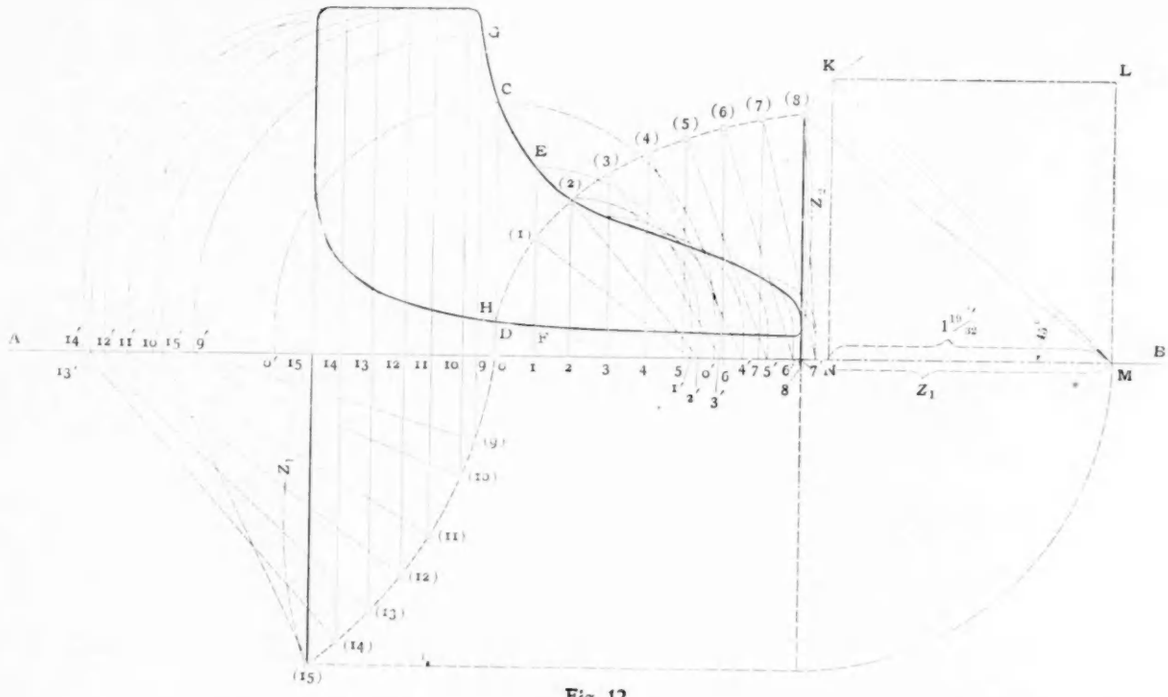

Fig. 12

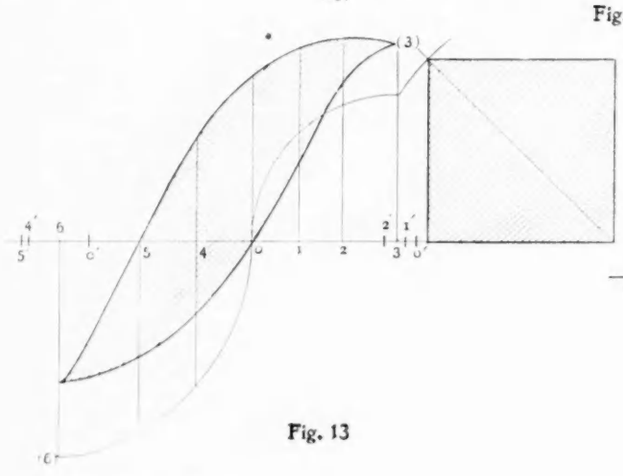

Fig. 13

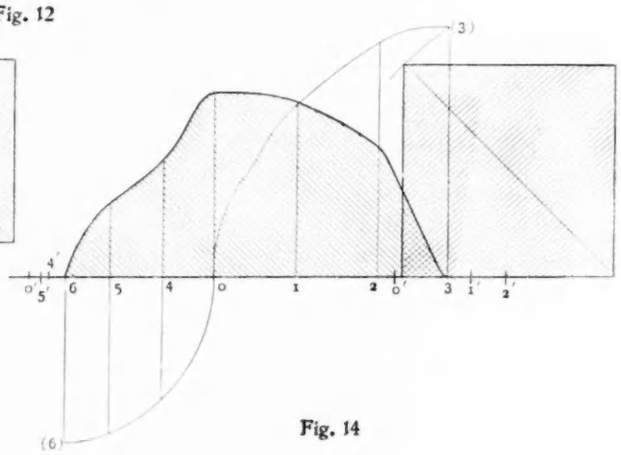

Fig. 14

Fig. 15

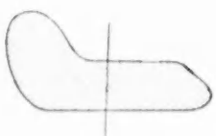

Fig. 16

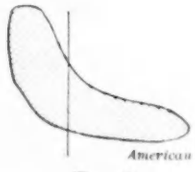

Fig. 17

APPLICATION OF THE METHOD

whose end-ordinates (found by transforming the right-angled triangle having the end-values as sides into an isosceles right-angled triangle having the same hypothenuse) is the side of the required square. In Figs. 13 and 14 two examples are executed in this manner, showing more strikingly the simplicity of the method. In Fig. 13 the horizontal axis cuts across the given figure, being placed through the point in which the bisecting ordinate leaves the figure; and in Fig. 14 advantage is taken of the shape of the area, and the axis placed in one of its boundaries. Figs. 13 and 14 also show the difference in effect of putting the bisecting ordinate to the right, or left, respectively, of its accurate position, in the former case the left-end value being greater than the right and the square found being some distance to the right of the given figure, while in the latter case the right-end value is greater than the left end, and the regular figure is overlapped by its square of equal area.

[How simple this method is will be seen from Figs. 13 and 14, which contain all the lines drawn in an actual application as explained in Mr. Wiener's last paragraph. Mr. Wiener does not say what amount of error is to be expected in case the first ordinate, CD of Fig. 12, does not accurately divide the area in halves or if the arcs for determining the z-curve do not accurately intersect at points half-way between the ordinates. As both these locations are to be determined by estimation, it is important to know the magnitude of the error involved, and for this purpose we have made the construction for a circle, first following Mr. Wiener's instructions as closely as possible, and then introducing errors at these two points. To complete the comparison the area of the circle was also determined by the usual method of adding the mean ordinates between the dividing lines. The circle thus treated was 3 inches in diameter, divided into strips ¼ inch wide, except that the outer strips, where the circle grows narrow very rapidly, were again subdivided into two. In the first determination the construction was made as accurately as possible in all particulars. In the second, the meeting points of the arcs were shifted 1-16 inch out of the center, except at the end divisions, which were so narrow that this displacement could not be made. In the third the center ordinate was shifted ¼ inch to one side, and in the fourth the addition was made on a long strip of paper in the manner commonly employed — this method being considered more accurate than the measurement of individual ordinates. The accompanying table gives the results compared with the true area:

True area	7.069	
First determination following Mr. Wiener's construction as closely as possible	6.990	1.2 per cent. short.
Second determination with arc intersections shifted $\frac{1}{16}$ inch	6.990	1.2 per cent. short.
Third determination with center ordinate shifted ¼ inch	7.128	.8 per cent. excess.
Fourth determination by addition of ordinates	7.165	1.4 per cent. excess.

It will be seen that the greatest error in the result by Mr. Wiener's method is less than that by the usual plan, and that the errors in the result introduced by the intentional errors in the construction are small, although these intentional errors were greater than will ever be made in practice. It should be said further, that a circle is probably among the worst forms for this method, owing to its being everywhere convex outward. Where the diagram is bounded partly by convex and partly by concave lines, as in Figs. 12, 13, and 14, the errors should be less. In a later communication Mr. Wiener says he has laid out trial diagrams composed of straight lines, semi-circles, and quadrants which could be easily checked by calculation, as in Fig. 15, and he seldom finds an error larger than ½ per cent. He also points out that the error due to the displacement of the middle ordinate depends on the shape of the curve. If its hight is uniform for some distance each side of the bisecting ordinate, as in Fig. 16, the error due to displacement of that ordinate is slight, while if a large change in this hight occurs at this point, as in Fig. 17, the error is greater. The error due to the displacement of the meeting points of the arcs also varies with circumstances. If these arcs meet at a considerable angle, as is the case between A_1 and A, Fig. 7, the error due to displacement of the meeting point is considerable, but if the arcs are more nearly tangent, as between A and A', Fig. 7, this error is less.—Ed.]

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Contributory Infringement.

Where an article does not of itself infringe a patent, but A makes or sells that article to B with the expectation that B will add other parts, making in the total a combination which infringes the patent, there A (and often also B) is guilty of *contributory infringement*.

This principle is an exception to the well settled rule of law, that a combination claim is only infringed by an article which embodies every element, or the substantial equivalent of every element, of the claim. This principle is steadily acquiring greater prominence in the law, and is of especial importance to shops which manufacture miscellaneous parts of apparatus.

The Courts have stated the matter as follows:

When one makes and sells one element of a combination covered by a patent, with the intention and for the purpose of bringing about its use in such a combination, he is guilty of contributory infringement, and is equally liable to the patentee with him, who, in fact, organizes the complete combination.

Where a party makes a device which is adapted to be used only in a patented combination, and is offering such device for sale to the public, he is legally presumed to intend the natural consequences of his acts, and an injunction will be granted against him.

The following cases, which have been actually decided, will explain the application of the principle:

A patent claim covered the combination with a lamp chimney of a burner made with the parts specified in the claim. A made and sold the burners but not the chimneys, and contended that, as he did not combine the chimneys with the burners, he did not infringe the patent. But the Court found him guilty of contributory infringement.

A patent covered a process. A had a license to use the process in the city of Philadelphia, and also a license to sell materials for use in the process to licensees under the process. He sold such materials to others than the licensees, and was adjudged a contributory infringer of the process patent.

A patent for a hammock covered, among other elements in combination, blocks for distending the hammock when in use. A made the blocks, which were not specifically covered by any claim, and sold them to dealers in hammocks, who combined the blocks with hammocks, thereby completing the infringement, and sold the combination to purchasers. The Court held that making and selling the blocks was contributory infringement.

A patent claim covered a fabric for collars and cuffs, having two outer layers of celluloid and an interlining of textile fabric. A made a textile fabric and sent it to B, who put a layer of celluloid on one side only, then returned it to A, who trimmed it and folded it, so that there was a layer of celluloid on each side of the textile fabric, and made it into collars and cuffs. It was held that A and B were both infringers.

The claims of a patent covered an under-running trolley in combination with other elements. A made and sold a trolley switch and harp, which of themselves did not infringe any claim, but could not be used except in combination with the other elements of certain claims. The purchasers from A combined the trolley switch and harp with the other elements of certain claims. A was held to be a contributory infringer.

A patent covered a machine for fastening buttons on shoes by means of wire staples. The staples were old and not covered by any claim. The machines

drove all other modes of fastening buttons by staples out of the market, and practically produced a monopoly in the use of the staples, because there was no other use for them. The machines were sold with a condition, which was stated on a plate affixed to each machine, to the effect that "This machine is sold and purchased to use only with fasteners made by the P. N. Company, to whom the title to said machine immediately reverts upon violation of this contract of sale." A furnished staples to certain purchasers of the machine, in violation of the condition. It was held that A was a contributory infringer of the patent, although the patent did not cover the staples *per se*.

D. WALTER BROWN.

111 Broadway.

▲ ▲ ▲

A Variable Speed Countershaft.

The accompanying cut will serve to show the essential features of a new variable speed countershaft especially adapted for driving machine tools, such as lathes, planers, drills, and, in fact, any machine where it is desirable and profitable to vary the speed, little or much, as the conditions of the work may require. Figs. 1 and 2 show precisely the same arrangement, except that in the former the adjustment is for the slowest driven speed, while in the latter it is for the highest, the slowest speed being, with the given speed of the driver, 85 revolutions per minute, while the fastest speed is 850 revolutions, a difference of 10 to 1. The long shaft at the right in each figure is driven from the line shaft by the pulley on either end, one being for the direct or forward drive and the other for the reverse or backing movement. The countershaft may be started in either direction by the friction clutches indicated. Tight and loose pulleys may, of course, be used, or a single tight pulley with a loose pulley on each side of it, all on one end of the shaft. This first shaft at the right drives the second shaft at the left by means of the endless belt and the conical flanges which press or clasp the edges of the belt, the changes of speed being accomplished by moving the pair of flanges on one shaft apart and at the same time moving the other pair of flanges nearer together, or *vice versa*. The moving of the flanges apart allows the belt to bear upon a smaller diameter of the cones, and bringing the flanges nearer together increases the diameter of the belt bearing. The flanges move freely endwise of the shaft, but feathers and splines cause the flanges and their shafts to turn together. The thrust collars which move the flanges have ball bearings, and are operated by the long levers shown in oblique positions on each side. These levers are fulcrumed midway between the two shafts, and they are operated for the purpose of changing the speed by means of the right and left screw at the extreme left. A sprocket on the end of the screw carries an endless chain which comes down long enough to be convenient for the hands of the operator. The construction of the endless belt is shown in Fig. 3. It is of special construction, being composed of a series of leather and iron strips riveted upon a rawhide base. A powerful grip is secured on the edges of the belt without in the least kinking it or getting it out of shape. Adjustment for wear is provided at the fulcrums of the levers, which may be moved inward or out by means of the long screw between the shafts. A plain pulley is shown for driving to the machine; in case of driving a lathe this would, of course, be replaced by the upper cone pulley. The range of speed variation in this countershaft and the ease of instantaneous change are features that should commend it to the mechanical world. It will interest our readers to know that with the necessary modifications this device has also been applied to motocycles, where a speed changing device is a great desideratum. The countershaft is made by the Reeves Pulley Company, Columbus, Ind.

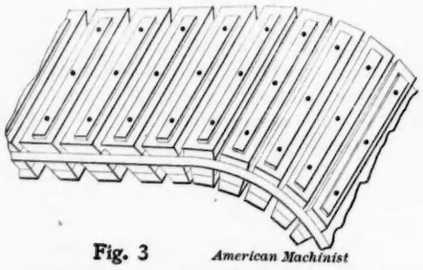


Fig. 3 *American Machinist*

BELT FOR VARIABLE SPEED DEVICE.

▲ ▲ ▲

Turning and Boring Irregular Forms.

A manufacturing company in Philadelphia requires a large number of dies of the outline shown by the outer circles of Figure 1, as well as female dies to match them, and has constructed the boring mill attachment shown in Fig. 2 for doing the work. The shape shown in Fig. 1 is composed of two circles, with centers at *a b*. The dies, so far as

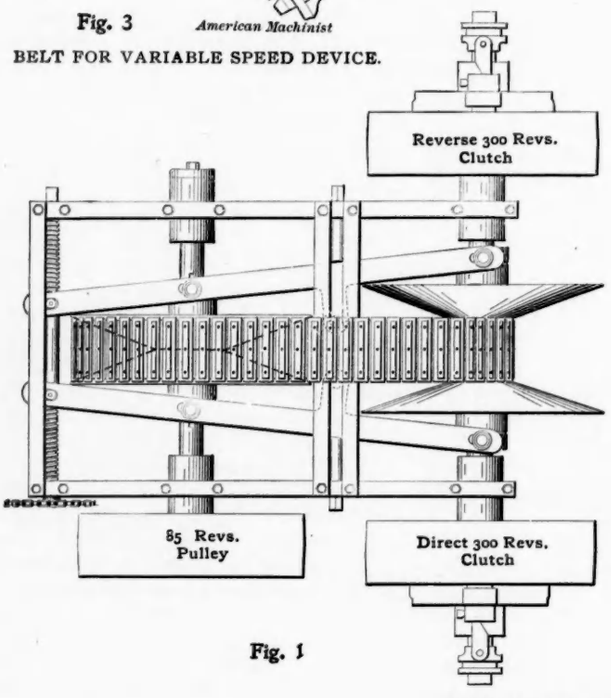


Fig. 1

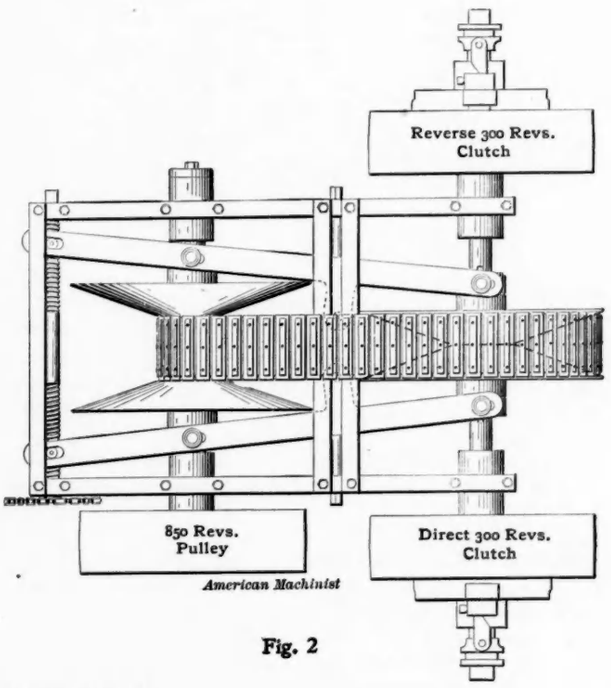


Fig. 2

A NEW VARIABLE SPEED DEVICE.

shape is concerned, might have been made in two pieces divided on the line *c d* without special appliances, but with the arrangement shown the complete die is turned as quickly as one-half of it would have been had two pieces been used, while the labor of jointing is entirely saved and the dies are far more substantial. The work could not have been done on a slotting machine, because some of the dies to be made are taper in outline and all have the corners squared out somewhat like an eccentric in the case of the male die and like an eccentric strap with the female die.

A bar, *a*, Fig. 2, is driven by the boring mill table and is supported near its upper end by a bearing, *b*, which is located in the center line of the machine. The bar carries a forming guide, *c*, which turns with the bar. The right hand head of the boring mill has its horizontal feed nut removed, while a bar, *d*, which is made crooked to suit the surroundings, is bolted to its head and at its left hand

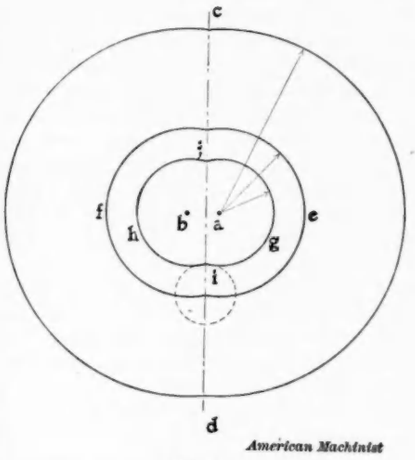


Fig. 1

SHAPE TO BE PRODUCED AND FORMER FOR SAME.

end carries a roller, *e*, which bears upon the former guide, *c*. A strong spring, *f*, connects the two heads by which, when the left hand head is screwed away from the right hand head, the roller *e* is made to bear heavily against the guide *c*. As the table revolves the roller riding on the guide will obviously cause the head and tool to reciprocate and produce the desired curve. In order to provide for the adjustment of the tool a supplementary tool box and slide has been added to the lower end of the regular tool bar, while in case it is desired to remove the tool bodily for any reason it is easily done by advancing the left hand head. A bar, *g*, connected to the right hand head has a stop at *h*, which engaging with stop, *i*, causes the two heads to move together.

The inner curves of Fig. 1 show the relation between the forming guide and the work produced. The outer circles being those of the work, it will be apparent that the curves *e f* are also circles, since they are parallel to the first. These circles would be proper for the guide if the roller was to be replaced by a rubbing point, but with the roller the former shape is that of the circles *g h*, whose radii are less than those of circles *e f* by the radius of the roller. These circles are, however, joined by arcs *i j*, having a radius equal to that of the roller as shown. It will be seen that with this radius the transition from circle to circle is abrupt as it would be with circles *e* and *f* and a rubbing point in place of the guide, this abrupt transition being necessary to suit the conditions of the work.

It will be seen that by adjusting the bar *d*, one former may be used for all

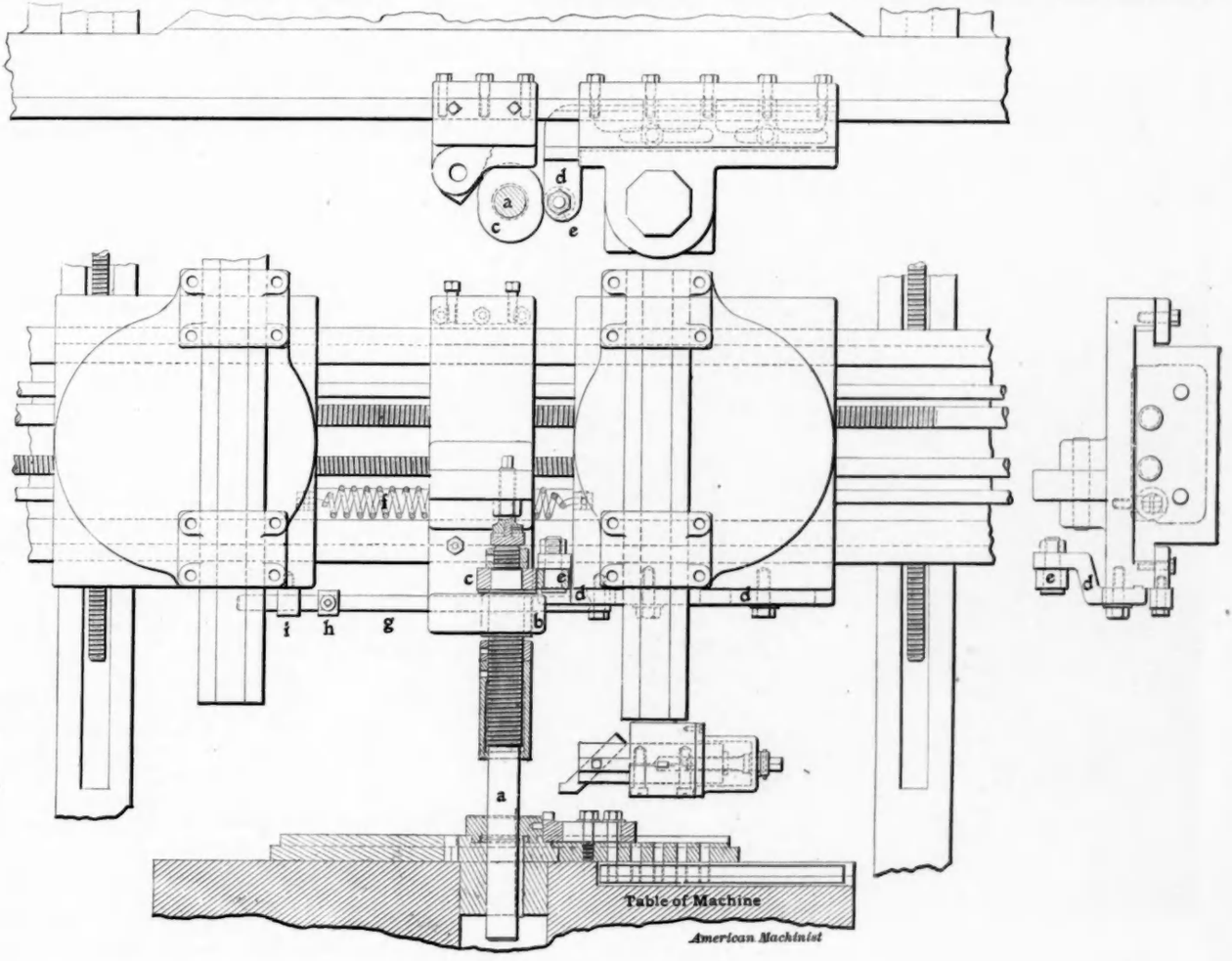


Fig. 2

TURNING AND BORING IRREGULAR FORMS.

diameters of dies having the same value for the distance between *a* and *b* of Fig. 1, and that by swiveling the tool head the dies may be made straight or taper as desired, while any width of work within the capacity of the mill may be made from one former, so that a comparatively small number of formers provides for a great variety of work. The formers being plain disks may easily be made in a slotting machine and so involve but slight expense.

The method is obviously adapted to a wide variety of work in addition to the shapes here required. About the only limitation upon it appears to be that the shapes to be produced shall not give too great a variation to the clearance angle of the tool.

▲ ▲ ▲

Vertical Spindle Miller.

We give an illustration of a milling machine which has some new features.

At intervals of 4½ inches notches are formed in the outer edges of the uprights and great pains are taken to have the bottom, horizontal surfaces, of these notches very accurately spaced.

Locking pieces are so arranged on the cross-rail as to automatically engage these notches as the cross-rail is moved upward, acting in this respect like pawls. After their engagement with any given pair of notches, the cross-rail is made to depend upon these by merely slacking the elevating screws a little, and thus the alignment of the cross-rail is made to depend upon surfaces which once made accurate will remain so, because there is no wear on them.

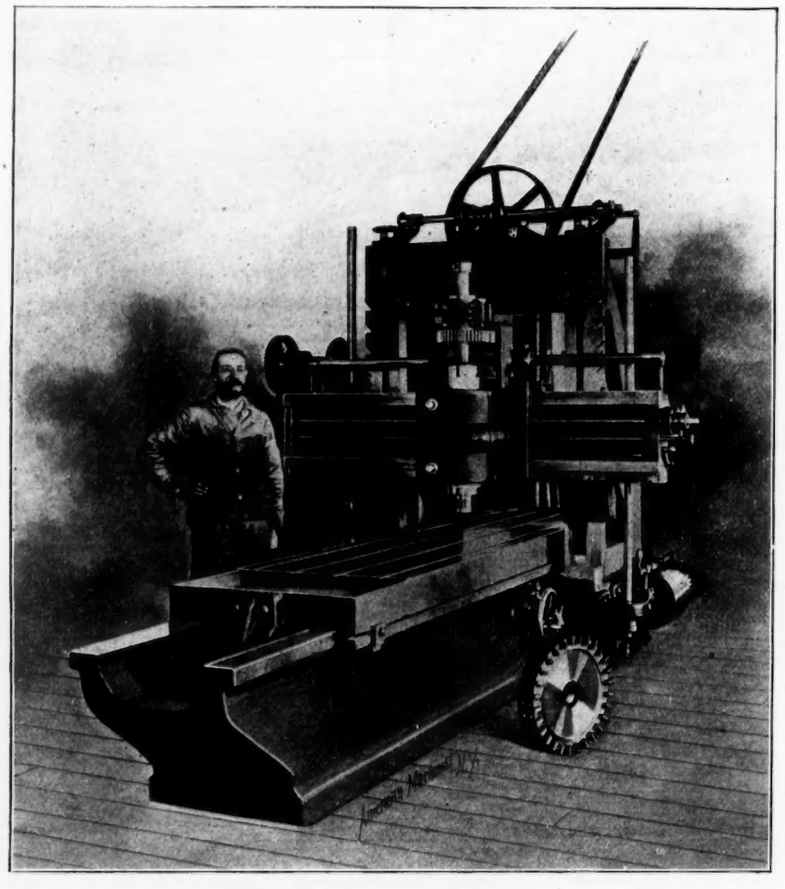
The movement of a lever throws the locking pieces out of the engaging position and permits the cross-rail to be lowered.

For setting the cutter to the work a fine adjustment is provided for the spindle, and the range of this adjustment is 5½ inches, so that the entire range of vertical adjustment between consecutive pairs of notches can be covered.

The feed motion for the platen is by means of a screw below and parallel to it. In feeding this screw is stationary and the nut is revolved upon it, the nut being also a worm-wheel. For the quick traversing motion of the platen, however, the nut is held still and the screw is rotated. The feed of the saddle upon the cross-rail is also automatic.

Reference to the engraving shows that the machine has all the usual facilities for handling and fine adjustment of cutters, and the range of speeds is suitable for cutters from 1½ inches to 21 inches diameter. There are eight rates of feed for each speed of cutter. The cutter spindle is of steel, is 5 inches diameter, and runs in bronze boxes, the lower one of these being adjustable for wear. It is taper, 5 inches and 4⅝ inches diameter, 6¾ inches long. Back-gear proportions are 8 to 1 and 16 to 1, and the largest step of cone pulley is 28 inches diameter for 4-inch double belt.

The distance between uprights is 38 inches, length of finished portion of table 120 inches, greatest distance between end of spindle and platen 40 inches. The platen weighs 6,000 pounds, and the whole machine 30,000 pounds. It is made by Blake & Johnson, Waterbury, Conn.



36"×36" VERTICAL SPINDLE MILLING MACHINE.

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Russian Railway Management.

From the press of the Caucasus come reports of curious "fines" imposed upon the employees of the Trans-Caucasus Railway. For example, an engine driver, in accordance with the rules laid down, requested a "conductor" to take the locomotive into an engine shed, and was fined "for making such a request." Conscious that he had done nothing contrary to the regulations, he asked for an explanation of his fine, and was then again punished by a further fine for "obstinate inquiry."

In another case an engine driver was also mulcted in a fine because one of the smoke pipes of his engine had become unfit for use. As the fault lay clearly with the locomotive maker, the engine driver was able to prove that he himself was not to be held responsible for the defect. He was absolved from payment of the fine for the unfit smoke pipe, but the penalty was at once reimposed upon him "for his stubborn demand to have the matter cleared up." Six railway guards were fined 7 shillings "for reports that were quite correct as to facts, but not in agreement with the reports sent in by the higher officers employed on the railway."—Pall Mall Gazette.

[Plenty of equally unreasonable and unjust things are done on American railroads, but such bald statements regarding them are not made on official records.]

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A private letter received from Gustav Diechmann & Son, Berlin, states that they have recently been very busy, particularly in the fitting up of their new and much more spacious quarters. They say they will be in a position to exhibit over 100 machine tools and that the building will be fitted with a traveling crane running the entire length, about 150 feet. They will also have every other facility for handling machinery in the best manner.

Letters from Practical Men.

Dovetail Joints in Patterns.

Editor American Machinist:

In pattern making the question often arises, What is the best and cheapest way to so put the work together that it will not warp or shrink out of shape and be strong and firm? This is most often the case in medium thin work, such as machine frames, hangers, disks, etc. The sketches show the method of putting such work together, which we have been using with success for quite a number of years. This is all done on a scroll saw and requires no hand work if well executed.

The machine should be in good condition and the saws properly filed in order to make smooth, clean work. Figures 1, 2 and 3 show the manner of getting out a disk or web used in a

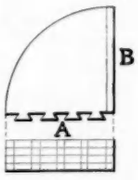

Fig. 1

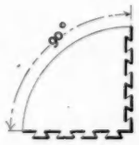

Fig. 2

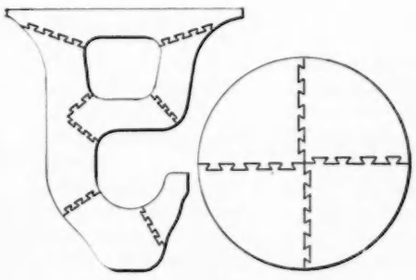

Fig. 5 Fig. 3

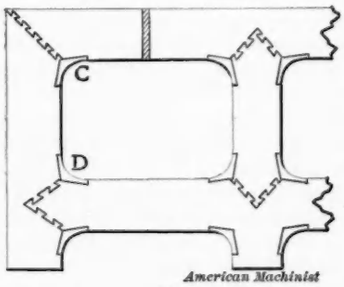

Fig. 4

DOVETAIL JOINTS IN PATTERNS.

great many different kinds of patterns. The pieces are first sawed roughly to size, allowing for finishing and also for the dovetail—this last on one edge only. The depth allowed for the dovetail depends somewhat upon the thickness of material used. The pieces are then packed together and held by a couple of wire nails. If in this case the material was ½ inch thick the pieces after packing together would be 2 inches in thickness. This is then squared up very accurately, allowing ½ inch on one edge for the dovetail. After being laid out on the edge *A*, Fig. 1, and sawn to size, the bottom piece is removed and placed on top, with the part *A* that has been sawn lying over *B*, a gage line having been drawn at *B* for the depth of the dovetail. *A* is then laid out on *B*, care being taken to get these pieces perfectly square.

The bottom piece is now replaced and the edge *B* is sawn, which then looks like Fig. 2. After withdrawing the nails the pieces can be glued together, forming a disk like Fig. 3. If the work is laid out accurately and is sawn closely to the lines it will come together without any trimming whatever. Fig. 4 shows the manner of constructing a pattern for the side frame of a machine, the corners *C*—*D* being let into the frame to avoid any thin edges. Fig. 5 is the main part of a hanger pattern. Other applications will suggest themselves.

WYMAN EATON.

Dolgeville, N. Y.

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Pickling Castings.

Editor American Machinist:

I should be glad to hear an expression of opinion from some of your correspondents in regard to the advisability of *pickling* machinery castings of moderate size, say under 1,000 pounds in weight. Remarks as to the methods might also be of interest to some expectant picklers.

The advantages of such pickling are, of course, the getting rid of sand which would otherwise have to be rubbed off or left on, and the removal of hard scale to prevent damage to cutting tools.

The disadvantage of pickling lies chiefly in the expense of the process; also, in some cases, in the fact that the surface of the iron does not hold the paint so well, although this, of course, is chiefly due to imperfect cleaning off of the acid.

In my own practice of many years I have been through various phases of the pickling fever, at times feeling inclined to perform the operation upon every casting that came into the shop, sometimes going up to a ton in weight, and at other times going to an opposite extreme, and pickling nothing. For very small castings, tumbling is doubtless a cheap substitute for pickling. For larger ones, the present most usual practice would seem to dispense with it altogether, for the sake of saving the expense, bother and delay. There are, however, many cases where tools, especially those of an expensive character like milling cutters, can be made to last much longer and maintain keener edges if the iron has been thoroughly pickled and entirely freed of hard scale.

Just where to draw the line in regard to these matters is a question that many of us would like to have answered, partly by getting the benefit of other people's experience. Hence this inquiry.

OBERLIN SMITH.

Bridgeton, N. J.

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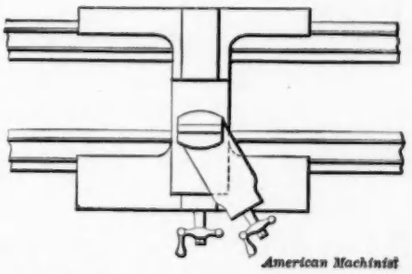
A Suggestion Aiming to Improve the Compound Rest.

Editor American Machinist:

From observation and frequent consideration of the subject I am led to concede the following proposition:

That when designers of machinery plan to have certain devices worked in a certain way and the various workmen persist in using them in a different way, the workmen, though they may be unable to explain why, are in the right, and the designer, though he cannot understand why, is in the wrong.

All the old readers of the "Machinist" who have honored me by following my various contributions will call to mind the many times I have called attention to the different way the compound rest is



AN IMPROVED COMPOUND REST.

used in Europe and in this country. It has always been plain to me why the English set the slide parallel to the ways of the lathe, but why the American workman always sets it parallel with the cross-slide has until recently been a mystery to me. And now I think I have solved it. In all our lathes without a compound rest the slot for the single tool-post is parallel with a line through the lathe centers, which is right, and as our compound rests are now made for a single screw tool-post the compound rest must be set parallel with the cross slide to bring the slot as the workman wants it. And if the tool-post is of the four bolt sort, the slide must be parallel with the ways, which our foot-stocks do not admit of, nor does the same reason exist as in the English lathe, for setting it parallel with the ways, and so to get the tool as the workman wants it the rest must be set parallel with the cross slide.

There are reasons why the compound rest ought not to set straight across the lathe; first, there is no use for two feeds to feed in the same direction; second, the two screw handles interfere or are inconvenient to get at, and, third, every machinist who is up to screw cutting knows the compound rest should set at an angle of 30 degrees, so as to take the

cut with the compound feed and back out and set in by the regular cross feed.

After making this discovery and going through the foregoing process of reasoning, the idea illustrated in the accompanying sketch at once suggests itself, and for our lathes, I believe, it would be by the workmen at once accepted as an improvement, at least where modern and common sense foot-stocks are adopted.

The angle of 30 degrees with some of the old wide base, short nose foot-stocks would not do, and the English would have no use for it, except when they accept the single screw tool-post also; but with properly designed lathes, with both the single screw and four bolt tool-posts, the compound rest built on the 30 degree angle plan would be an improvement.

JOHN E. SWEET.

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The Cone Lock.

Editor American Machinist:

We notice in your last issue the various names given by lathe builders to the shifting dog which locks the cone pulley of the lathe to the large spindle gear, namely, "lock bolt," "cone lock," etc.

We think the following would be more appropriate: "Obsolete" and "back number."

JONES & LAMSON MACHINE CO.
James Hartness, Mgr.

[We are not sure but that our friend Hartness would, with suitable provocation, extend the application of his remarks to cover all the rest of the lathe besides the cone lock; but however that may be, it is safe to predict that such friction clutches as are now almost universally applied to turret machines will be equally common on lathes up to 20-inch swing. A lathe is very often used on a class of work which would fully justify the extra cost of such a clutch, and we know of at least one lathe builder who expects soon to make such a clutch a feature of his lathes.—Ed.]

▲ ▲ ▲

The Wrench on the Cone Lock.

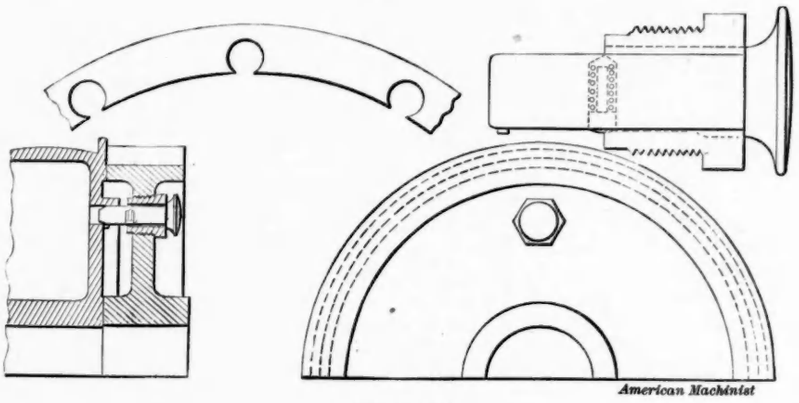
Editor American Machinist:

I note what Mr. Bury says about the wrench on the cone lock. I have had some of the same experience that he has gone through. The tool-post wrench should, of course, be solid, so that it will stay where it is most wanted, and when this wrench is used for the nut lock, and a fellow is in a hurry, it is not a rare thing to get the wrench caught, and either break it or strip the screw or pinch his fingers, or do some other delightful thing. I can't say that I ever learned to love the knurled thumb nut for the business, as I have had more than one that would persist in getting loose. Whether a wrench is used or not, the lock that slides in and out radially in a slot is not, in my opinion, the best, both on account of the problem of securing it conveniently and also because the spindle cannot be perfectly balanced with it in both positions. The only perfectly satisfactory cone lock that I have known was a straight pin with a little head on it that shoved in and out parallel with the spindle, with two little half round grooves around it and a spring to drop into one or the other of the grooves and hold it securely in either position, when the cone was locked and when the back gears were in use. I do not know why something of this kind is not more generally used.

There are many ways in which this push-in pin may be used; the sketch herewith is only a suggestion of one among the many. A bush is screwed into the web of the gear to give a longer guide for the pin. The cone has a projecting circular rib with several holes in it for the lock pin to drop into. We might as well have a dozen of these holes as a single one, so that it will not be necessary to turn the cone very far to find a place to lock, the lock-pin holes cut through the inner side of the circular rib to allow the little stop pin to clear. The bush or guide for the lock pin has a large spline on one side, which allows the stop pin to pass through. Then on the opposite side of the hole in the guide is a shallow circular groove in which the rounded head of the little spring actuated plunger moves. When the lock pin is first inserted it is turned half way round, and it is then in its working position. When the lock pin is pushed clear in as shown, and the cone is locked, the plunger drops over the corner of the bush and holds the lock pin from working back. When the lock pin is pulled back so that the stop pin strikes the end of the bush, thus releasing the cone, the plunger drops over the corner where the circular groove is deepened, as shown by the dotted lines, and holds the lock pin in that position. If the lock pin is turned half way round it may be taken right out at any time.

CYRUS T. BROWN.

St. Louis, Mo.



A CONE LOCK.

Mechanical Refrigeration by Compressed Air.

Editor American Machinist:

As I did not see the proof of my article upon this subject in your issue of April 21 (page 286-22), and some textual mistakes have crept into it, will you kindly permit me to say that in the first column of the page, fourth line from bottom, the word "expanse" should have been "expense." In line 17, second column of same page, the word "mechanical" should have been placed before the word "refrigeration." The minus sign should have been placed before the figures 217.08° Fahr. in line 60, first column of page 23-287, and also in line 32 third column of same page.

I am much obliged for the well-intended and probably needed attempt in your editorial columns of the same issue, under the title "The Expansion of Compressed Air Through a Nozzle," to make the matter still clearer than I was able to make it in my article. The illustration selected for this purpose, however, seems to me singularly unfortunate.

My article was directed, not to the confirmation of the fact that air expanding freely from a nozzle effects only a very small part of the final cooling it is capable of producing when expanded under best conditions for obtaining refrigeration, but to an explanation of causes for the different results obtained by different methods of applying the work of expansion.

The illustration used to add clearness to my exposition is, therefore, not pertinent to the subject, unless it serves the same purpose of showing why the results of the different methods of applying the work of expansion are different. I cannot see that it does this in any measure whatever. There is no analogy between the heating of air by compression and the reheating of expanded air by impact of particles of air thrown at high velocity from the orifice of a nozzle.

In the case cited in your editorial re-

marks the air in the compressor is heated not by work performed by itself, but by work performed by another expanding mass exterior to itself. The volume of the air in the compressor *is diminished*, while the velocity of its particles is increased.

In the case of air expanded from a nozzle the velocity of the particles is increased by impact at the expense of the velocity of the mass driven out by its own expansion; in other words, *by work performed by itself upon itself*, the reheating occurring by the arrest of the mass velocity which causes the impact, *and while the volume of the mass is increasing.*

You will, I think, admit that the two sets of phenomena thus placed in contrast are about as unlike as possible.

I am at a loss to see why Mr. Rust, in his letter entitled "Proportions of Compound Air Compressor Cylinders," did not quote the first edition of Prof. Du Bois' translation of Röntgen's "Thermodynamics" (New York, 1880), instead of a later edition. A very simple demonstration of the fact that minimum work of compression in a compound air compressor requires the intermediate pressure to be the square root of the product of the initial and terminal pressures is to be found on page 325 of that book.

The equations necessary for the determination of this relation were given in a French treatise on "The Theory of Ice Machines," translated and printed in Van Nostrand's "Engineering Magazine" back in the seventies, and soon thereafter published in book form by the same publisher.

Substantially the same fundamental equations, presented by Prof. Rankine, were printed in the Transactions of the British Association prior to 1860.

The same relation is also distinctly implied in the general practice of designers of compound engines. We have but to change the signs of both members of an equation expressing the relation of volumes for compound expansion to get an equation for volumes in compound compression. LEICESTER ALLEN.

[Mr. Allen is in error in his second correction of typographical errors. In this instance the article as printed and his manuscript agree. Our editorial comment was intended to emphasize the difference between external and internal work. In the case of a steam compressor driven by air the work is done by one body of air on another body of air, and while one gets cold the other gets hot. In the case of expansion through a nozzle the two actions are combined, that is, the work is done *by* and *on* the same body of air, and one largely neutralizes the other, so far as temperature effects are concerned. It seems to us that this does show "why the results of the different methods of applying the work of expansion are different," and we consider the illustration entirely pertinent and not at all unfortunate. So far as the criticism of Mr. Rust is concerned, we scarcely think it should be expected of him to have every edition of Röntgen's treatise on his shelves, and it was no more than natural and usual for him to quote the edition at hand.—ED.]

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Systematic Arrangement of Parallel Strips.—A Place to Keep Milling Machine Arms.

Editor American Machinist:

The parallels used on planers and for general work in machine shops and tool rooms are usually not kept in such a manner as to make their use convenient. A parallel strip must usually be of some definite hight relative to the vise jaws and the work, and this involves some measuring and often some trying before just the right thing is found. When no system is followed in keeping the parallels the operation is often a bothersome and somewhat tedious one. The rack for keeping parallel strips shown herewith is intended primarily to do away with most of the measuring and also to show at a glance what strips are available and not in use.

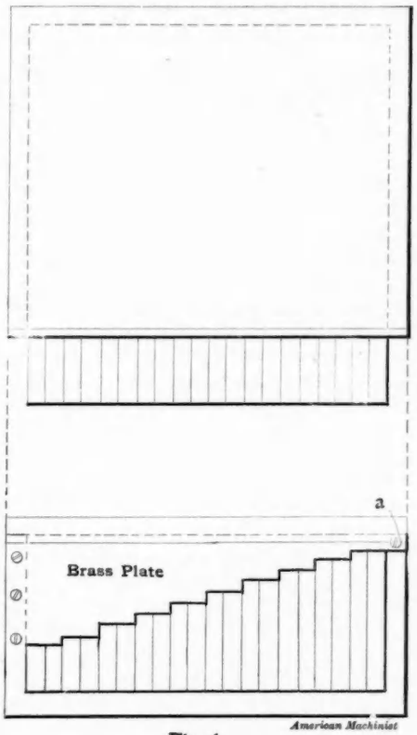

Fig. 1

SYSTEMATIC ARRANGEMENT FOR KEEPING PARALLEL STRIPS.

For the milling machine more particularly I have a set of hardened and finished steel parallels, 5 inches long, ¼ inch thick. They are in fourteen pairs, beginning at ¼ inch wide and going to 1 1-16 inch wide, and are kept in a box as shown by Figure 1, end and plan views. In this case the front of the box is made of brass and the lower portion left open, the lower edge of the brass being stepped to fit over the parallels. Just above the strips is a line on the brass which represents the hight of the vise jaws on the machine and as the strips stick out of the box about 1 inch, all that is necessary is to place the work or a scale on the parallel and select the one over which the job comes the proper distance above the vise jaws, as shown by the line referred to.

Where the parallels are used on several different machines or vises having different hight jaws, lines representing each different hight may be drawn on the brass and designated by any desired marks. This method of keeping parallel strips will save a great deal of time and quickly pay for its small cost and is moreover a source of great satisfaction to the men using it. Of course it is not necessary to have a set of parallels like those shown, but a box may be made for those already on hand.

It is sometimes a problem in a crowded shop what to do with the overhang arms of the milling machines when not in use. They usually take up bench room or are stood up in a corner, where they are liable to fall down and mash someone, or laid on the floor, where it will break one's back to lift them up and then make him say things while he wipes the dirt and muck off to be able to put them in place. The stand shown in Fig. 2 will avoid most of this trouble and besides makes a very handy arrangement.

Referring to Fig. 2, *A* is a cast iron cylinder about 10 inches high, with a flange at the bottom drilled and countersunk for screws to hold it down to the floor. It is bored out inside to about .003 inch larger than the overhang arm and the mouth is well rounded out, as shown, for entering the same. In the side and near the bottom is planed a slot similar to a key way and in the bottom of that is held a piece of leather, as shown at *C*. This leather valve covers a ½ inch hole that leads to the outside

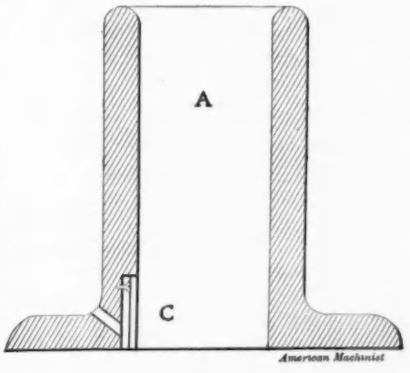

Fig. 2

A PLACE FOR THE OVERHANG ARM OF A MILLING MACHINE.

as shown. This stand may be screwed fast to the floor, back of the milling machine and quite close to it, to be clear out of the way of everything, but not close enough to interfere with any of the feed movements. Some heavy paper or rubber packing should be put under it to make a reasonably tight joint between the flange and the floor. It will be seen that when the end of the overhang arm is entered in this an air cushion will be formed underneath it, which will cause it to gently settle down to the floor without any jar, and when it is needed again it is in a very good position to be lifted up. The valve *C* will open and the air coming in through *D* will allow the arm to come up as easy as if it were standing in the corner, which corner, aside from its other disadvantages, is sometimes a considerable distance from the machine.

THEODORE H. MILLER.

Brooklyn, N. Y.

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To Make a Glazed Emery Wheel Cut.

Editor American Machinist:

In the column of "Questions and Answers," No. 43, under date of April 14, 1898, "W. T.," New York, asks: Can you tell how to make an emery wheel cut freely on the side which is badly glazed over? Here is a way I have never seen fail to work. Sprinkle emery (grade to suit the case) on a planed cast iron surface, then slide the wheel around on it, applying pressure by bearing down, or placing a weight upon it. By chalking the wheel to tell how it runs for truth before taking it off of the arbor, and then bearing on the wheel in order to cut the most off at the chalked parts, it may be made to run very true. The grains of emery rolling under the wheel cuts the glaze all away, leaving it as good as new.

D. S. M.

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A Modification of the Link Motion for Mogul and Ten-Wheeled Locomotives.

Mogul and ten-wheeled locomotives offer a peculiar difficulty in connection with their link motions. The forward and middle drivers are so close together that if the rock shaft is carried through between them the eccentric rods become very short and give rise to a great increase in the mid gear lead over that of the full gear. To avoid this many such locomotives have been made with crooked rods reaching over the forward axle. The spring of such rods, however, introduces difficulties which many consider worse than those due to short rods.

With this we show a modification of the gear introduced by the Richmond Locomotive & Machine Works with two ten-wheeled passenger engines for the Southern Railway, by which both these difficulties are overcome. It will be seen that the link does not directly engage the rocker, the latter being placed at *a*, considerably in the rear of the former. The eccentric rods are of such length as to locate the link well forward behind the forward driver, while the rock shaft is located between the forward and main drivers. The motion is then conveyed from the link to the rocker by a bar *b c*, which is hung from the lower end of the rocker and from a supporting link *d e*. It will be seen that the bar carries the motion of the link to the rocker without change, and permits any reasonable length of eccentric rods to be used.

These are said to be the largest passenger locomotives in the world.

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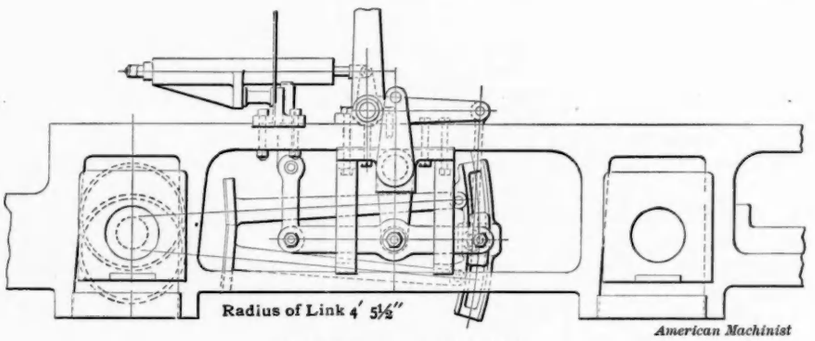
Electrically Driven Machinery and Other Matters at the Electrical Exhibition.

A feature of the electrical exhibition at the Madison Square Garden, of this city, is a series of lectures on electrical topics. The first of these, by Dr. S. S. Wheeler, was delivered during the evening of May 12 on the topic of Electrically Driven Machinery. It was delivered in the concert hall of the building, and was ostensibly before the New York Electrical Society, under whose auspices the exhibition is being held, but in point of fact it was of a strictly popular nature, and the audience was composed chiefly of visitors to the exhibition. A large number of lantern pictures of a great variety of electrically driven machinery was shown, and a few such machines were shown in motion. These comprised an emery wheel, a lathe and a small portable drilling machine. The drilling machine was fitted with a powerful electro-magnet by which it was secured to the work (a good sized angle plate), and a small hole was put through. The lathe was suspended by a chain block and was swung about while at work. Just what of value such an exhibition is supposed to show is not clear, but it and the drilling of the hole through the angle plate were greeted by rounds of applause, which had every appearance of being by an organized claque on the part of the members of the society. The exhibits were, as a matter of fact, rather trifling in character, and judging by the reasons given for the adoption of electric driving, one is forced to conclude that if there were no other reasons than those put forth by the electricians the system would never have reached its present degree of prominence. The saving of power, the unsightliness and cumbersomeness of belting, the manual exertion necessary to shift belts, the great strength necessary in overhead ceilings, and the necessity for accurate aligning and plumbing of belted machines, were the leading reasons put forth for the abolition of shafts and belts, while the distinctly misleading impression was given that the individual motor is the common plan. The individual motor drives but one tool, while a group motor drives many, and while there are probably more individual than group motors, there are, according to our observation, and this largely in the electrical companies' own shops, far more machines driven by group than by individual motors.

One part of Dr. Wheeler's lecture related to the progress made in adapting machines to their motors so as to make the two integral parts of the same structure. This progress is illustrated by many of the exhibits at the exhibition, though there is, of course, much lack of harmony in the designs of motor and machine.



MODIFIED LINK MOTION.

This condition is probably unavoidable and permanent, owing to the two ends of the combination being designed and made at different places. In general, however, there is no such harmonious adaptation of machines and motors as is to be seen in direct connected engines and dynamos.

An excellent exhibit of the show is that of the X-ray apparatus, which is the most successful and satisfactory that we have seen. The bones of one's hand are defined with surprising clearness, and it is plain that such an apparatus must be at times of great assistance to a surgeon.

Another exhibit which deserves to be a center of attraction, and would be if

properly attended, is the apparatus used for wireless telegraphy. There is, however, no attendance whatever, the apparatus being inclosed in a glass case with cards stating that the apparatus without connecting wires rings a bell on the opposite side of the hall, and if one desires he can go and see the bell.

Another exhibit which deserves attention is the Monarch engine stop and automatic speed limit. In these devices a suspended weight constantly tends to close the throttle valve, but is prevented from doing so by a ratchet and pawl. The pawl is disengaged by an electro-magnet, which may be operated by push buttons located in various parts of the works. A small governor driven by the engine is so arranged that a slight excess of speed completes the circuit of the same electro-magnet and hence stops the engine. The devices are of obvious utility and are very neatly gotten up. The various push buttons may easily be used whenever the engine is stopped, and the operating condition of the apparatus be thus assured.

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Niagara Falls Meeting of the American Society of Mechanical Engineers.

The official program for the spring meeting of the American Society of Mechanical Engineers, which will be held at Niagara Falls from May 31 to June 3, gives the following list of papers to be read at the meeting:

Barrus, Geo. H.: Plea for a Standard Method of Conducting Engine Tests.

Donkin, Bryan: Extension of the Standard Uniform Methods of Conducting and Reporting Steam Engine Tests.

Woolson, O. C.: The Hanging and Setting of Fire Tube Boilers.

Baker, C. W.: What is the Heating Surface of a Steam Boiler?

See, Jas. W.: Patents.

Bryan, W. H.: Relations between the Purchaser, the Engineer and the Manufacturer.

Lowry, Geo. A.: One Hundred Years of Ginning and Baling Cotton.

Thurston, R. H.: Graphic Diagrams and Glyptic Models.

Norton, Chas. L.: The Protection of Steam Heated Surfaces.

Cole, F. J.: Bending Tests of Locomotive Stay-Bolts.

Johnson, J. E.: Note on the Carbon Contents of Piston Rods.

Benjamin, C. H.: Experiments on Cast Iron Cylinders.

Carpenter, R. C.: Mechanical Properties of Certain Aluminum Alloys.

Carpenter, R. C., and P. J. Fickinger: Method of Manufacture and Tests of a New Seamless Tube.

On May 31 there will be an opening address by Hon. Arthur Hastings, Mayor of Niagara Falls, followed by an illustrated description of the work and methods of the Cataract Construction Company, by Messrs. Coleman Sellers and W. A. Brackenridge. An unusually extensive series of excursions and sightseeing has been planned, and the meeting cannot fail to be both highly profitable and entertaining, and a record-breaking attendance may be expected. The members are to be kept so busy that no evening will be available for the presentation and discussion of papers, this business occurring only at the three full morning sessions.

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Foreign News Notes.

There is a fruitful field in Manitoba for contractors and dealers in railroad supplies, owing to the fact that the Government has enacted measures which will bring about the construction of about 500 miles of road in that province, in extensions of existing lines. Three lines are to be extended, all converging in Winnipeg.

Capt. Watson W. Rich, late chief engineer of the Sault Ste. Marie Railway, has been appointed consulting engineer to the Chinese Railway Administration, with headquarters at Shanghai. He will be in charge of all railway building in China, and is under the immediate direction of the Director-General of Railways.

A concession has been made to Robert G. Reid, of Montreal, Canada, whereby he will take charge of, combine and complete all the Government railroad lines in Newfoundland, which will hereafter be known as the Newfoundland Railway. The agreement will continue in force for fifty years. One line to be extended is that from Whitbourne, to join a line at present running to St. John, at a cost not to exceed $100,000; a line from Topsail to St. John, at a like cost; both to be completed before December 31, 1898.

There is but one railway in the Philippine Islands, and that extends from Manila to Dagupin, a distance of 123 miles. It is single track, well built, steel rails being used its entire length, the bridges being of stone or iron, and the station buildings substantial.

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Naval Appropriations.

The Naval Appropriation bill, as it has been passed and approved, carries with it the following appropriations:

For the purchase and erection of new and improved machinery for the shops of the gun plant in Washington, $36,000.

For the purchase and manufacture of smokeless powder, $250,000.

For the erection of buildings on Government grounds for the manufacture of smokeless powder, together with the necessary machinery and equipment, $93,727.

For one locomotive crane and track for dry dock, Port Royal, $70,000.

For workshop and boiler house for ordnance, League Island Navy Yard, $60,000.

The following appropriations were made for the purchase of tools and machinery: Navy yard, Boston, modern machine shop tools, $15,000; Navy Yard, Norfolk, tools, handling machinery and new boilers for machine shop, $35,000; Key West, Fla., tools for machine shop, foundry and boiler shop, $30,000; Port Orchard, Wash., machine tools to fit out plant for repairs of engines, boilers, etc., $30,000; Port Royal, tools for repairing engines, boilers, etc., of U. S. naval vessels, $50,000.

The President is authorized, in the bill, to contract for three seagoing coast-line battle ships, to cost, exclusive of armor, not exceeding $3,000,000 each, one of which is to be named the Maine; he is also authorized to contract for four harbor defense vessels of the monitor type, to cost, exclusive of armament, not exceeding $1,250,000 each; sixteen torpedo boat destroyers, of about 400 tons displacement, and twelve of about 150 tons displacement, to cost in all not exceeding $6,900,000; one gunboat to take the place of the United States steamship Michigan, to cost, exclusive of armament, not exceeding $250,000, the same to be constructed on the Great Lakes or their connecting waters.

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A recent patent for a typewriting machine seems to be a record breaker in the extent and number of its claims, which occupy nearly twelve pages of the "Patent Office Gazette," the number of distinct claims being 158.

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At a recent meeting of the British Institute of Naval Architects a speaker narrated an incident that should be remembered by those who press melted lead: "Some years ago, in a factory where lead pipe was 'squirted' by hydraulic pressure, a small hair-like leak occurred. The pressure was 1,500 pounds to the inch. A man going for a spanner crossed the stream, which, acting precisely like a knife, cut open the inside of his thigh and severed the femoral artery. The man was dead in a couple of minutes."

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The following description of the sounds attending the starting of a factory, taken from the May issue of one of our leading magazines, will be of interest to engineers who may have had occasion to watch the flutter of eccentric straps:

"A bell sounded from the factory tower, and you could hear the first slow movements of the piston rod, and the answering stir among the fly wheels as they warmed to swifter motion, and the eccentric straps and pulleys tuning up to the canticle of the working day."

Accurate Screw Machine Work—Turning Tools.

BY J. O. SURFACE.

The hollow mill holds the time-honored place among tools for turning in a screw machine, but while it may be a most effective tool, it is not always so, as, if

Fig. 1

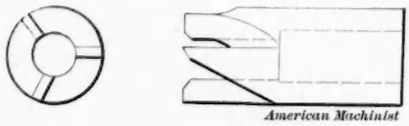

Fig. 2

HOLLOW MILLS.

not properly constructed, it will cut neither smooth nor straight.

I well remember my early efforts in making them with anything but good results. They would tear when cutting steel, and on brass work would cut small and tapering.

No machine tool except threading dies requires as much care and experience to make satisfactory.

If the cutting edges are radial, as in Fig. 1, they will not cut as easy as when set ahead of the center, about three-eighths of the diameter of the work being turned, as shown in Fig. 2. In this way the cutting edges make a shearing cut, and, further, if the cutting edge is beveled about 30 degrees, so that the chips will roll off at an angle the same as from a diamond point, it will cut easier, but, of course, leaves more work for the finishing tool.

Of course hollow mills must be reamed slightly the largest at the back end, or, what is better, ground that way after hardening, and for accurate work a ring should be clamped over the cutting end to adjust to correct size.

Three teeth are sufficient for hollow mills used for roughing; and though they do not cut three times as fast as the single cutting edge of a box tool, yet, if made as just described, it is a rapid cutting tool.

As they usually spring in hardening, instead of putting them directly into the turret, as is customary, and having only one or two teeth cutting, making rough and taper work, it is best to make them short and mount them in "floating holders," Fig 3, which can be set central and then clamped, making all teeth cut equally.

This floating holder is a valuable tool and not used as widely as its merits deserve. It is especially valuable in bitting, counterboring and reaming holes, as will be shown later in an article on chuck work.

For short work, and especially for cast iron, the knee tool, shown in Fig. 4, is convenient, as it admits of a wide range of adjustment, but it is not suitable for long turning, as there is nothing to support the work opposite the tool and it will not turn straight.

For accurate work, when used with power feed for turret, the box tool in some form is used, on account of being adjustable to different sizes, easy sharpening of tools and certainty of turning round and straight. The older style of tools, shown in Fig. 5, were made with cutting edge on top, the same as forged lathe tools, but these were not convenient to adjust, usually no method being provided except "sledge hammer adjustment," which is slow and unreliable. Also as the top and side of the tools were frequently ground as well as the end, the hight of cutting edge would not remain correct and the shoulders turned would not be square.

The end cutting tool in box tools makes an entirely satisfactory outfit, for after the bottom has once been ground to just the slight angle needed to cut smoothly the tool can be easily removed, ground on end only, replaced in box tool, and will require only slight adjustment, if any, to cut smoothly and the correct size.

Box tools are frequently made with a bushing back of the cutting tools, but if the tool is set by accident to cut even one-thousandth too large the work will stick in the bushing, and not only requires driving out, but frequently the bushing must be lapped out, as the stock from the work becomes welded to the bushing and cannot be removed by other means. The surface of the back-rests should be very hard and smooth to burnish the work, and must be ground parallel to the work.

The tool should be adjusted on a piece projecting but little from the chuck, the back-rests moved away from the work, and when tool cuts one or more thousandths large, according to size, the back rests should be pushed with the fingers against the work quite hard and clamped in place.

Fig. 6 shows another style of box tool useful in some cases, the bushing being ahead of the tool; and there are also two cutting tools, one taking off most of the stock, not necessarily cutting smooth, and the other tool taking only a light chip and making a smooth surface and the correct size. This, of course, cannot cut close to the chuck, and will turn no nearer round than the stock used, but can be fed rapidly.

All things considered, back rests permit of the nicest work and permit turning straight close to the shoulder, and also close to the chuck.

Pieces with two or more sizes turned, if made in large quantities, should have special box tools with a cutting tool for each size and the proper distances apart

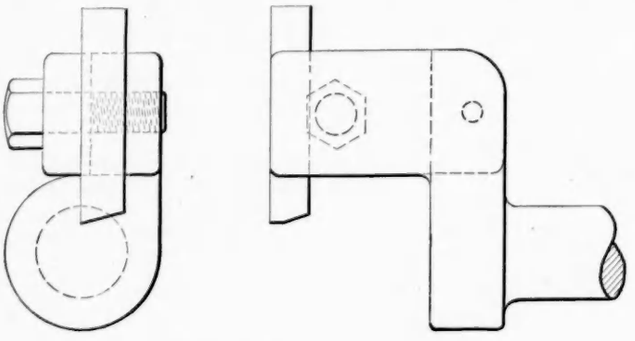

Fig. 4

KNEE TOOL.

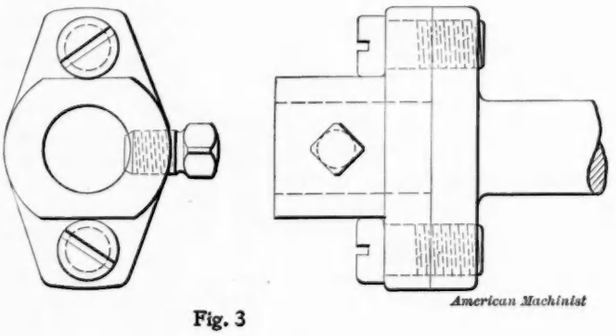

Fig. 3

FLOATING HOLDER.

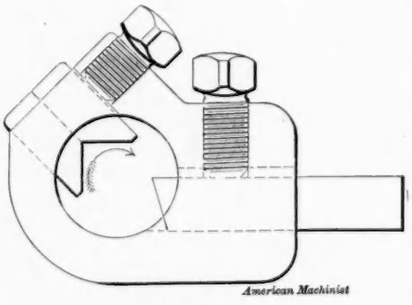

Fig. 5

END VIEW OF TOP CUTTING BOX TOOL —"HAMMER ADJUSTMENT."

for the shoulders. This insures concentricity and accurate lengths, and also economy of time, if the work is roughed out with a similar tool, as the last cut requires feeding only the length of the longest shoulder turned.

The best class of work requires the points to be finished after threading.

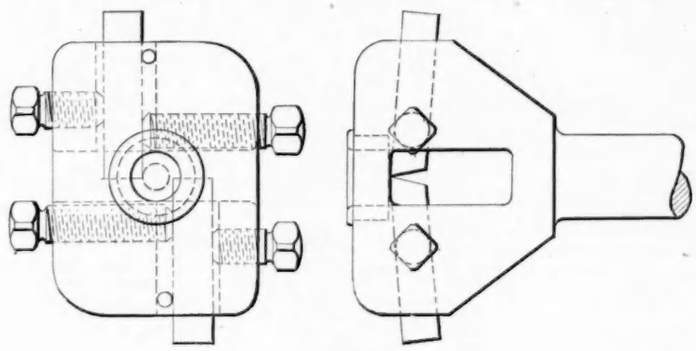

Fig. 6

BOX TOOL.

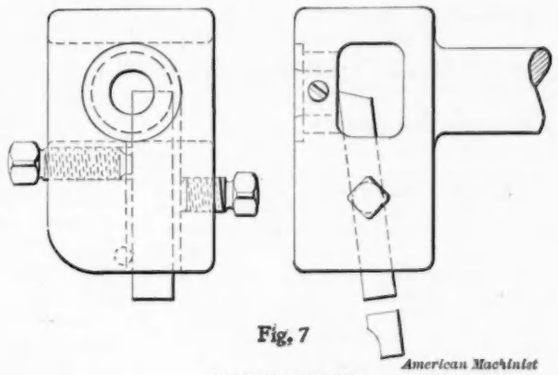

Fig. 7

POINTING TOOL.

Fig. 7 shows a tool for this purpose. The work runs in the bushing just ahead of the tool, the tool being made the correct form its whole length, and can be sharpened without changing its form. Of course the point should be roughed to

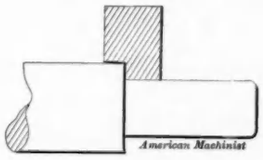

Fig. 8

nearly the right form before threading, for too heavy a chip will close in the first thread and make the screw start hard.

Cutting a thread often raises a burr on the outside of screw, but one or two strokes of the file during the cutting off

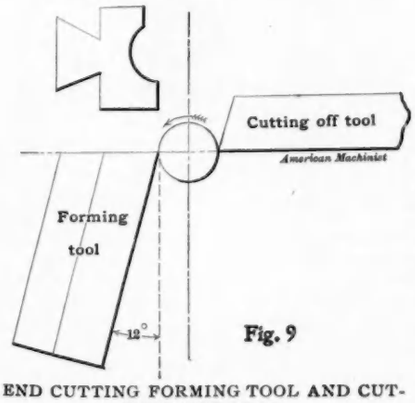

Fig. 9

END CUTTING FORMING TOOL AND CUTTING OFF TOOL.

will remove this and make the work much better to handle.

The box tools or hollow mills also often throw up a burr around the head of a screw being turned. This can be removed when drawn stock is used by making the cutting tool in the box tool with a lip or cutting edge just right to shave the edge of the head when turning the body, the lip being at a slight angle to avoid shaving the head the whole length. See Fig. 8.

When the heads are irregular form or any irregular work is made, a tool cutting on the end and held, as shown in Fig. 9 is very serviceable, as the form of work being on the whole length of

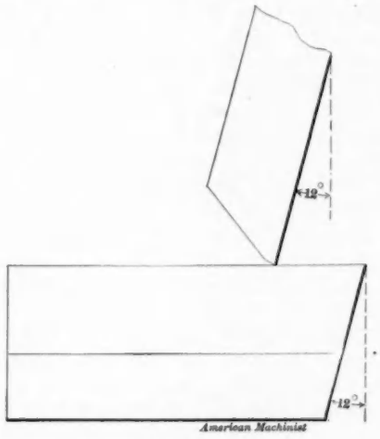

Fig. 10

PLANING A FORMING TOOL.

the tool, it can be ground on the top till nearly all is worn away and still retain the correct shape. A clearance of 12° has been found correct in most cases for these tools. If the work being made must have the form very accurate this clearance must be allowed for in making the tools, and is easily done by planing out the tool with a master or fly tool of the exact form, but inclined to the same angle at which the tool is to be used, as seen in Fig. 10. In this way one angle exactly compensates for the other, and the only inaccuracy will be the amount the tool springs in hardening.

Circular tools are often used for irregular work, as they are conveniently formed into the shape desired, but to cut freely the tool, if used on the front slide, with work running forward—the customary way—should be set below the center to give proper clearance. A tool 2 inches in diameter should have its center ⅛ inch below the center of work, which equals about 7°.

Some workmen object to circular tools because they are difficult to hold, but with a suitable clamp on the outside, as shown in Fig. 11, there is no trouble.

The cutting-off tool is, of course, best used on the back side and set to cut off with spindle running forward to avoid reversing the spindle on work not threaded, and on threaded work it avoids loss of time from the workman reaching the shift more than once for each piece.

Thanks are due the Brown & Sharpe Manufacturing Company for the opportunity of illustrating some of the tools and methods used in their screw machine department.

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It is announced that the Elwood Ivins Tube Company, of Philadelphia, has succeeded in producing a 1 per cent. nickel aluminum tubing which has all the characteristics of pure aluminum, but is very much stronger. It is reported that they are making a large quantity of this tubing for the War Department.

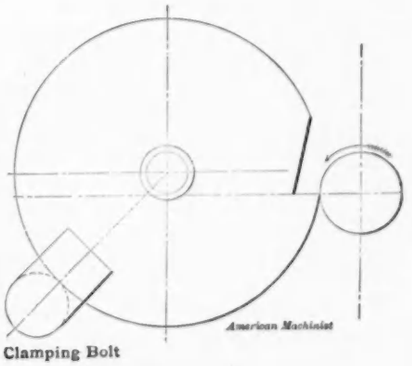

Fig. 11

CIRCULAR FORMING TOOL IN POSITION

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Justifiable Mathematics.

We are well aware that mathematical work of any kind beyond the simplest is on the defensive, and, growing out of the fact that we have of late published rather more of this class of matter than is customary, some mutterings have reached us. There are in fact those who, if we were to devote 1 per cent. of our space to matter of this kind, would overlook the remaining 99 per cent. and condemn our practice in toto.

It may be well to state two leading cases in which we consider matter of this kind to be justifiable in our columns. The first is that in which subjects are put in simpler form than they have previously been reduced to. By this we do not necessarily mean that they must be reduced to a form in which they can be handled by the multiplication table. Any substantial simplification brings a subject within the grasp of some of those who were previously unable to grasp it, and on that account is, in our opinion, justifiable. The second case is that in which mathematical work, even though it may be of a somewhat advanced character, gives rise to new and practical solutions of old problems.

The article which we publish elsewhere this week from the pen of Mr. A. E. Wiener, on finding the areas of irregular diagrams, is of the latter character. In fact we have seldom seen a piece of work based on advanced mathematical conceptions which had such a happy and simple outcome. Mr. Wiener has given us what we believe to be an entirely new method of finding the areas of indicator and other diagrams by graphical construction, the accuracy of which, in view of the statements made in the appendix to his article, is undoubted, while a trial will show anyone its real simplicity.

Those of our readers who can follow a calculus demonstration will find in this article a piece of work which will delight them by its beauty and outcome, while those to whom this pleasure is denied will have no difficulty in gathering the process to be followed from the final paragraphs, and will find a method which can be used without an understanding of the reasoning by which it is demonstrated to be correct. Such use of it of course takes its accuracy for granted, but there are comparatively few engineers who do not do this more or less in daily work. Some would condemn this, but we cannot see wherein. A celebrated professor once said that he would not allow a student to use a table of logarithms until he could calculate it for himself, to which an apt reply was made by asking if he would not allow a boy to use a watch until he could make one himself. The answer to this question is not yet recorded, and we doubt if it ever will be. It is no more reprehensible for one to make use of the results of mathematical work which he cannot follow than it is for an astronomer to use a telescope or a surgeon a case of instruments which he could by no possibility make. We are all dependent on the labor of others, and it is no more to one's discredit to make use of a mathematician's work than it is to make use of a mechanic's work. Dependence upon others is in fact a leading characteristic of civilization as distinguished from barbarism, and between dependence on the mathematician and the mechanic we can see no real difference.

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Professor Sweet's proposition at the beginning of his letter in another column of this issue will be rather startling to many. Especially so to those machine designers who imagine that intelligence regarding machine tools and their uses begins and ends in the drawing room. It will be noticed that the proposition is carefully stated. It does not mean that the user of a lathe or other machine tool knows more about how to handle it properly than the designer, but it does mean that when a considerable proportion or all of the users of a given tool *persist* in using it in a certain way there is a good reason for it, and that if their way is different from the way intended by the designer of the machine, he had best reserve his remarks about the stupidity or the obstinacy of workmen and set himself to the task of finding why and in what way his design is wrong. The proposition is one well worth thinking over.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(48) W. W. F., Cochranton, Pa., asks: What is the best method of cleaning light, frail castings such as cannot be rattled? If a pickle is used is it practical to dust the face of the mold with facing? A.—The sand-blast should clean the castings in a way that would leave little further to be desired. It would be well to place the castings for treatment in a box with a bottom of wire grating, so that the sand may be caught to be used over again. As to the use of facing, some experimenting, with the advice of the best practical molder within reach, should afford a better answer than we can offer.

(49) P. W. C., Birmingham, Ala., asks: If a given volume of steam at 100 pounds gage pressure is compressed, what will be the consequence? Will the pressure remain at 100 pounds, with condensation of all the steam except enough to maintain the pressure, or will the pressure rise? A.—The pressure will, of course, rise, and no condensation need necessarily occur. The compression of steam to a higher pressure occurs at every stroke of any good steam engine, as evidenced by indicator diagrams. With the compression and accompanying rise of pressure there will be also a corresponding rise of temperature.

(50) Chantrell Tool Company, Reading, Pa., writes: We have a few malleable iron castings that we wish to harden, and would like to have them hard all the way through. Can you give us a receipt? A.—We are not sure that you can harden these castings all the way through; that will depend somewhat upon their thickness. They can be hardened to a considerable depth, however, by heating, preferably in a lead bath to a cherry red, immersing in cyanide, again heating and then quenching in cold water. A preferable method, however, is to heat them in a bath of red hot cyanide and then quench in water. This makes the castings very hard.

(51) X asks: What would be the smallest safe size to turn down a piston rod for a single action ammonia compressor, 11 inches diameter by 27 inches stroke, 200 pounds condensing pressure? The original diameter of the rod is 2 7-16 inches. Please give formula if convenient. A.—We assume that this rod is made of steel, and the authoritative formula giving the smallest size for a piston rod for an engine would be that given by Unwin, which is as follows: $d = b, D.\sqrt{p}$. In which $b = .0144$ for steel. This would give for the size of this rod 2.16 inches.

but the fact that the pump is single acting and that the rod is subjected to compressive stress only instead of alternate compressive and tensile stresses as in an engine piston rod, would probably make it safe to reduce the rod to 2 inches, though in doing this it should be remembered that there is a strong probability that the rod was originally made about the size that the makers of the machine had found it advisable to make it, and any material reduction of diameter ought not to be made except as a necessity.

(52) J. F. G. asks: In the case of an ordinary punch for punching metals, what relation does the power required to punch the various thicknesses hold to the thickness punched, all other things being the same, and, all things being equal, what relation does the power required hold to the size of the hole punched; does it vary as the area or as the perimeter? I have seen conflicting rules given, and refer to you for the correct one. A.—The best formula we know of is as follows: $P = 80\ D\ T$, in which $P =$ pressure in tons, $D =$ diameter of hole punched and $T =$ thickness of the metal. It is not to be understood that this rule will give exact results, but it is probably nearly correct for average conditions. By this rule it would require about 43.75 tons to punch a ⅞-inch hole through a 5/8-inch plate, but experiments have shown that the actual force required to do this varies from 33 to 35 tons, though under different conditions the pressure might rise to that indicated by the formula. From this formula it will be apparent, of course, that the pressure does not vary as the area but as the perimeter, the perimeter being in direct proportion to the diameter of a round hole.

(53) F. W. A., Philadelphia, asks where he can find instructions for making blue prints. A.—You will find full instructions for making first quality prints in our Questions and Answers column for March 4, 1897. The directions there given embody our own experience, and, with the proper quality of paper, give results which we have never seen surpassed. The only additional item that could be given relates to the time of exposure. With clear sunlight this had best be determined by the clock. With a cloudy sky experience is necessary, though we may say that we have always followed the practice of opening the frame and examining the lines rather than attempting to judge by the color of the projecting border. Many do the latter, but we think that uniform results are not so easily obtained by that method as by examining the lines. When the exposure is right the thin lines will have turned blue, while the heavy lines, the title, etc., still remain the original color. With proper care as good results can be obtained with light requiring a half hour exposure as in clear sunlight. The universal tendency is to over expose.

(54) A. H. B., Mason City, Ia., has a tube closed at one end and with a funnel-shaped mouth at the other, and wishes to know the pressure in the tube due to different velocities of wind blowing against the funnel end. A.—Modern experiments on this subject do not give concordant results. All observers agree that the pressure varies as the square of the velocity, but there is a wide range in the coefficients obtained. Two formulas thus obtained are

$$P = .004\ V^2$$

and

$$P = .0029\ V^2$$

in which

$P =$ pressure per square foot in pounds

$V =$ velocity in miles per hour.

Smeaton's old formula was

$$V = .005\ V^2$$

There is no doubt that the pressure per square foot is less for large surfaces than for small. It also varies with the altitude and probably with the temperature. We do not see that your funnel-shaped mouth would affect the pressure. 2. What is the composition used for metallic piston rod packing. A.—A leading Eastern railroad uses the following: Tin, 100 parts; copper, 9 parts; antimony, 6 parts. These are to be melted in separate crucibles, and when at the most fluid temperature the tin is to be poured into the other metals and the mixture well stirred with a stick of green wood. Especially should an iron rod be avoided as a stirrer, as particles of iron will be taken up and produce hard spots in the metal. Lead should also be avoided in alloys for this purpose, as it will collect dust and act as a lap on the piston rod. The use of separate crucibles is considered important by some. Others do not consider this necessary, but first melt the copper, then add the antimony in small pieces, and finally the tin. Still others melt the copper and antimony in one crucible and the tin in another, pouring the tin into the other metals when all are at their most fluid condition.

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Technical Publications.

FATIGUE OF METAL IN WROUGHT IRON AND STEEL FORGINGS. H. F. J. Porter, of the Bethlehem Iron Company, South Bethlehem, Pa. 55 6x9 inch pages, with 31 illustrations.

This pamphlet, which is reproduced from the journal of the Franklin Institute, is of great and practical value. Starting with a discussion of the comparative merits of iron and steel forgings, it gives records of tests of the two materials, and maintains with convincing force that the opinion still held by some that for severe duty iron is the better material is entirely erroneous. At the same time, Mr. Porter goes into the origin of this belief and shows that the failures of early steel forgings were due to their having been made by the old method of welding up under a light steam hammer—a process which is well adapted to the properties of iron, but not to those of steel. This position is sustained with striking force by an account of the tests made on the broken shaft of the "Dolphin." Test pieces were taken from the shaft at various points in its diameter. Those from one side of the center were tested as they came from the shaft, and showed 21.4, 5.5, 4.9 and 2 per cent. elongation for the outer, second, third and inner specimen, respectively. The specimens from the opposite side of the center were cut out too large and then forged down to the size of the first set of specimens, and were then tested and showed 25.4, 28.2, 26.4 and 24 per cent. of elongation respectively. Several half-tone illustrations of broken shafts are given, showing piped centers whi h light hammers had not closed up. A good deal of space is devoted to a description of the methods and accounts of the results of endurance tests of iron and various grades of steel, while the subjects of hollow forged, fluid compressed and nickel steel are discussed in a very instructive manner. We are not informed of the price of the pamphlet, or if it has any price, but we are quite certain that it contains more information on the subject of heavy forgings than can be found elsewhere in the same space or, for that matter, in a good deal more space.

THE RESISTANCE AND PROPULSION OF SHIPS. By W. F. Durand. 461 6x9 inch pages, with 116 illustrations. Wiley & Sons'. Price, $5.

This book occupies a field in which there is plenty of room for it. The literature of the marine engine and the propeller is fairly voluminous, but the most important contributions to the subject of ship design must be searched for through the transactions of engineering societies and the technical press. The present book has been prepared in order to provide a connected treatise on the subject—a considerable amount of original work being, however, incorporated with existing information.

In a subject of the complexity of this the use of the calculus is almost a necessity, and it has been used where necessary, although the book does not by any means "bristle" with mathematics. The general handling of the subject is, moreover, such as to enable one who cannot read calculus to obtain a general view of it, while the formulas used in the actual solution of problems are reduced to simple algebraic processes. The book concludes with eleven pages of data relative to the leading elements of existing ships, and their propellers, speeds and horse powers.

A COURSE IN MECHANICAL DRAWING. By John S. Reid. 122 6x9 inch pages, with 168 illustrations. Wiley & Sons. Price, $2.

"Of the making of books [on mechanical drawing] there is no end." This latest text book covers geometrical problems and projection, with some attention to conventions and lettering. But little space is given to construction drawings and designing, it being the author's purpose to follow this volume with another devoted especially to that subject.

The work is a good one and can be recommended, but at this date it is scarcely to be expected to contain anything new. The field would seem to be exhausted, and we can see no need of additional books to cover it.

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Futile.

"Spain has no chance to win in this fight," said Mr. Manchester to Mr. Northside.

"Of course not," replied Mr. Northside. "A nation of mandolin players has no business to contend with a nation of machinists."—Pittsburg Chronicle Telegraph.

A Full Compressed Air Street Car Equipment for New York City.

We are at last it seems to have an adequate and exhaustive trial of the adaptibility of compressed air for surface traction. It may be said of every case where compressed air has heretofore been tried for street car propulsion that it has been more or less experimental and provisional in character, and the results attained have been such as could not properly be published without apologies or explanations as to the inadequacy of some of the apparatus employed. In the present instance the best skill and the ripest experience are backed by unlimited means, and we may be assured that in every respect the conditions essential to success will be availed of. The friends of compressed air, if it has any, and those whose business interests and personal convictions make them favor other devices, should be able to accept the results of the promised installment without question. It is authoritatively announced that the Twenty-eighth and Twenty-ninth street crosstown line of the Metropolitan Traction Company, of New York, is to be fully operated by compressed air. Twenty cars will be employed of the same type and general appearance as the Broadway cars, and the Hoadley-Knight motor will be used. The power house will be at the west end of the line. The air compressor will be of 1,000 horse-power, of the Ingersoll-Sergeant four-stage, single-acting, vertical type, the engine being a Reynolds vertical cross-compound condensing, built by the E. P. Allis Company. The air cylinders will be below the engine, submerged in tanks, with intercoolers between each successive pair, and a cooler also after the last compression. The working pressure will be from 2,000 to 2,500 pounds. The American Air Power Company, which was formed by the combination of the Hoadley-Knight and the Hardie companies, is the contractor. Experiments have been carried on extensively at the power house of the Metropolitan Traction Company, at 146th street, and cars have been running satisfactorily on Lenox avenue without attracting the attention of the public. As soon as the compressor is ready the cars can be started on the lines first referred to.

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An American engineer distinguished himself shortly before the declaration of war by his brave action in Barcelona, Spain. The morning of April 20 a mob of from three to four thousand people filled the square in front of the American consulate, cheering for Spain and making hostile demonstrations. Our consul, Mr. Herbert W. Bowen, who was breakfasting across the street, pushed his way through this crowd, took up his position on the steps of the consulate facing the mob and stood there waiting results, when he noticed a tall man pushing his way through the crowd and who, when he reached the steps, took his place beside the consul, and the two stood there together for about a quarter of an hour, facing the mob until police and soldiers arrived to disperse it. The consul then asked his comrade who he was, and was informed that he was Norman Harrington, of Chicago. "This is my first day in Barcelona; it seemed to me as if there would be some trouble for the eagle up there and I thought I would take a bit of it," he said. Norman Harrington, though he lived in Chicago, was representing at the time the firm of E. P. Allis & Co., of Milwaukee, which company had sent him to Australia and elsewhere as an engineer, and he was at the time at Barcelona in charge of the installation of some machinery made by that company.

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It is proposed to hold in 1901 at Cayuga Island, N. Y., a Pan-American exposition, the purpose of which will be the illustration of the development and progress of the American continent in manufactures, commerce, etc.

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A very disastrous boiler explosion occurred recently at the works of the Passaic Rolling Mill Company, Paterson, N. J. Two out of a battery of twelve boilers blew up, instantly killing one man and injuring several others. At this writing the cause of the explosion has not been ascertained.

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So the navies of Spain and of the United States, which rank in power far below those of Great Britain and France, but which contain some of the latest and best of armored warships, confront each other for the great experiment that may test the fighting machinery of modern warfare on the sea. But the adoption of all these mechanical forces and devices makes a new demand upon the qualities of men. They need as much as ever coolness, courage and endurance, but impetuous dash and fury and the prowess of sheer physical vigor must give place to mental qualities involving knowledge and aptitude for directing mechanical forces and skill in handling mechanical appliances, with the ready resource of brain keyed up to energy, but free from blinding passion. The machine is less than the man controlling and directing it, and the revolution in naval warfare will give a vast advantage to a people trained to mental alertness and clearness and apt in the invention and handling of mechanical devices.—A. K. Fiske, in New York Times.

Personal.

Chief Engineer C. P. Howell, U. S. N., has been ordered to the "Newark."

Lucius P. Gibbs, of New York, has been appointed acting assistant engineer, U. S. N.

Lyman B. Perkins, of Hartford, Conn., has been appointed acting passed assistant engineer, U. S. N.

Charles P. Forgham, of Schenectady, N. Y., has been appointed acting assistant engineer, U. S. N.

Charles F. Taylor, of Merchantville, N. J., has been appointed acting assistant engineer, U. S. N.

Acting Passed Assistant Engineer S. H. Bull, U. S. N., has been ordered to the "Prairie" immediately.

F. C. Williams, U. S. N., has been appointed Acting Assistant Engineer, and ordered to the "Prairie."

Chief Engineer D. P. McCartney, U. S. N., retired, has been ordered to the Washington Navy Yard.

M. E. Cooley, U. S. N., has been appointed acting passed engineer, with the relative rank of lieutenant.

Naval Cadet K. G. Castleman is detached from the "Franklin," May 21, and ordered to the "Newark."

Chief Engineer W. F. Worthington, U. S. N., has been detached from the "Sterling" and ordered to the "Lancaster."

Passed Assistant Engineer L. D. Miner, U. S. N., has been detached from the Norfolk Navy Yard and ordered to the "Sterling."

Passed Assistant L. W. Wooster, U. S. N., retired, has been ordered to the "Michigan" in the matter of receiving duty May 16.

Henry W. Spangler, of the University of Pennsylvania, Philadelphia, has been appointed acting passed assistant engineer, U. S. N.

Chief Engineer D. P. Jones, U. S. N., retired, has been ordered to Munhall, Pa., in charge of the steel inspection for the Pittsburg district.

Messrs. Alder & Boyd have assumed charge of the New York office of Wells Brothers & Co., of Greenfield, Mass., recently opened at 37 Warren street.

Passed Assistant Engineer J. L. Gow, U. S. N., has been detached from the "Prairie" and ordered immediately to the Boston Navy Yard with the "Vulcan."

Mr. H. A. Hoy, manager of the locomotive works, and Mr. Hughes, who has charge of the "carriage and wagon" department of the Lancashire & Yorkshire Railway at Horwich, England, are visiting this country to see what they may in the way of improved appliances and methods of doing work. Horwich is an exceptionally interesting place for an engineer to visit, and is "wide open." We